ONTARIO FOOD PROCESSING

RESEARCH & SERVICES COMMITTEE

1999 STRATEGIC REPORT
FOR 2000 TO 2004

TO
ONTARIO AGRICULTURAL SERVICES
COORDINATING COMMITTEE

January 2000

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I. Executive Summary

Ontario's dynamic food processing and agriculture sector is one of the largest and most diversified in North America. The province boasts 1,200 food and beverage processors, which employ approximately 85,000 people and generates more than $22 billion a year in sales.

Ontario is also a leader in food technology research and development. While much of this research is conducted by industry there remains a significant role for publicly funded research in the food area. The Ontario Food Processing Research and Services Committee (OFPRSC) has a mandate to identify and priorize food research and non-research needs to facilitate the effective conduct of publicly funded food R&D and service. This report presents the deliberations of the 1999 committee and its expert subcommittees.

While the OFPRSC report is directed at all levels of food research funders, the Food Research Program at the University of Guelph which is funded through an enhanced partnership with the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) is a key user of the information. The University of Guelph Food Research Program will be preparing a new four-year plan in 2000. In support of this planning effort, the 1999 OFPRSC has attempted to take a broader and longer term view of the industry in order to generate this Strategic Report for 2000 to 2004.

The Ontario Expert Sub-committees on: Cereal Grains and Oilseeds Products and Processing; Fruit and Vegetable Products and Processing; and Meat Products and Processing met and prepared reports that are contained in the appendix. This year, information was also gathered from other organizations and industry participants to ensure a broad, strategic view. This outside input outlined very similar themes to those presented by the subcommittees and a summary is also presented in the appendix.

The subcommittee reports identify R&D priority areas as well as some non R&D priority areas. The R&D priorities have been grouped under the following headings:

A. Food Quality and Safety

B. Value-added Products and Innovative Technologies

The OFPRSC did not rank these areas however; the subheadings under these priorities are taken from the subcommittee reports where priority ranking did take place. Some details of the subcommittee priorities are contained in the OFPRSC report. For a more thorough understanding of the issues and background behind these priorities, please refer to the subcommittee reports that are included in their entirety in the appendix.

Non-R & D priorities were identified in two areas, namely Genetically Modified Organisms (GMO's) and Consumer Education. The GMO issue was problematic for the OFPRSC, as it was for the entire industry in 1999, and will no doubt be the subject of much discussion again in 2000.

II. Introduction

The Ontario Food Processing Research and Services Committee (OFPRSC) is one of the eight committees operating within the framework of the Ontario Agricultural Services Coordinating Committee (OASCC). OASCC has a mandate to review the broad aspects of agri-food research, extension and education in Ontario to:

- facilitate communication and coordination among its members;
- assess immediate and future needs, and develop proposals and recommendations to address them;
- advise on joint uses of people and facilities; and
- contribute information and ideas about regional and national policies affecting agriculture and food.

The OFPRSC consists of four expert sub-committees: meat products; cereal grains and oilseeds; fruit and vegetables; and dairy products. In 1999, three of the four expert sub-committees held formal meetings; the dairy products and processing sub-committee did not meet. The expert sub-committees met to establish research and development and non-research and development priorities. These have been presented to the OFPRSC, and summarized into overall recommendations for Ontario's food processing sectors. The recommendations will also be presented to OASCC for approval. They are then distributed to managers of research/education/inspection programs in Ontario to provide direction to their programs.

Membership in both the OFPRSC and the expert sub-committees is comprised of representatives of the food industry, academia and government.

This report is the first four year strategic report of the OFPRSC as recommended by the 1998 OASCC Review. Annual reports prepared in the next three years will serve as addenda to this report. Due to changes in the OFPRSC leadership over the past year, consultations to support this strategic report have not been as extensive as originally envisioned, however efforts have been made to seek input from other groups and individuals outside the usual subcommittee process. A summary of the findings of these consultations is included in the appendices and was largely consistent with the priorities identified by the subcommittees.

The Ontario Ministry of Agriculture, Food and Rural Affairs provides approximately $1.5 million annually towards food processing research and development in Ontario through the Enhanced Partnership Agreement with the University of Guelph. Research is conducted by researchers affiliated with the Food Science Department, the Horticultural Research Institute of Ontario, Kemptville College, and Laboratory Services Division, and other departments of the University of Guelph. The OASCC recommendations are used in the development of research priorities for the Food Research Program. The Food Research Program is in the final year of the 1997-2000 plan and a new four year Food Research Program will be presented to the Agricultural Research Institute of Ontario in April 2000.

The recommendations made by OFPRSC also guide the establishment of priorities for OMAFRA competitive research funds and other research programs in Ontario managed by Agriculture and Agri-food Canada and Health Canada.

III. OFPRSC Terms of Reference

A. To identify and evaluate food research and development (R&D) as well as service needs and issues within the province.

B. To present and prioritize recommendations that facilitate the effective conduct of publicly funded food R&D and service.

C. To encourage coordination, dialogue and networking with the aim of maximizing the use of food and service expertise and resources.

D. To establish expert subcommittees to identify and evaluate industry sector food R&D and service needs and issues.

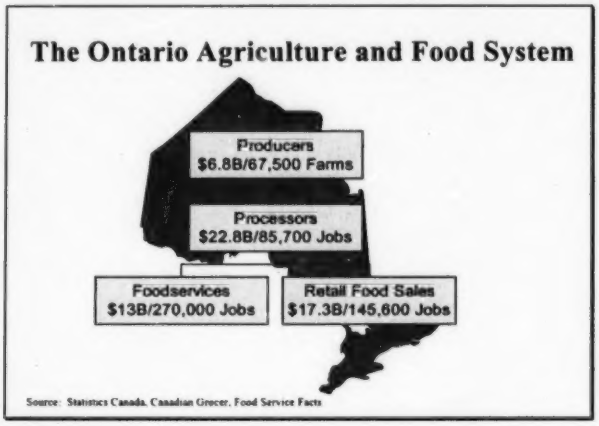
E. To report to the Ontario Agricultural Services Coordinating Committee (OASSC) annually, or more often, if requested.

IV. State of the Food Processing Industry

Highlights

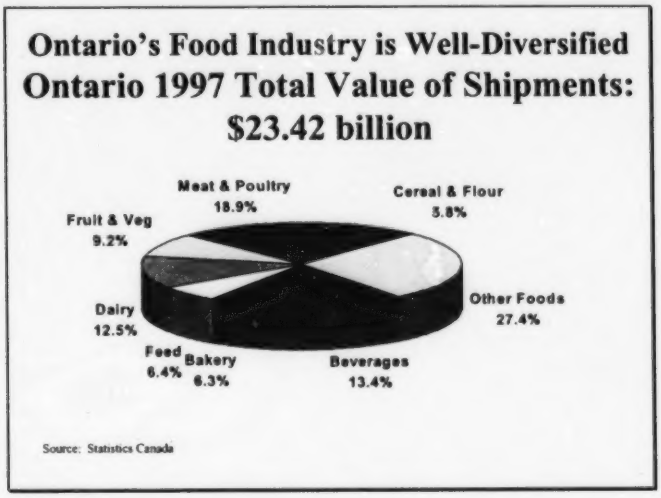
The Ontario food processing industry is a vital part of Ontario and Canada's economy:

- Ontario processors provide 85,700 jobs while the food service and retail food sale sectors combined for over 415,000 jobs.

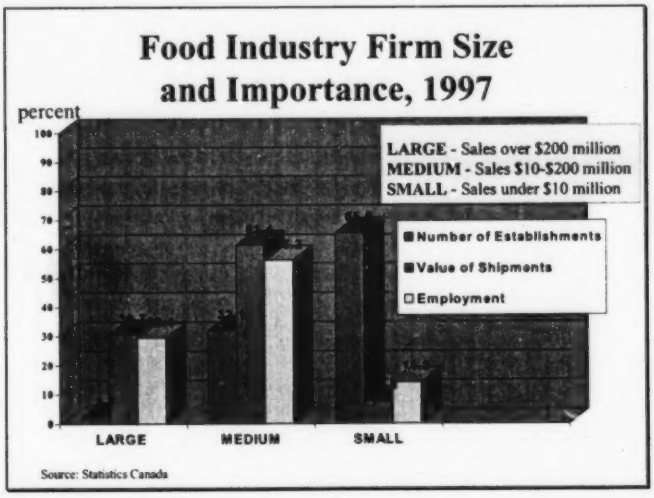


- The Ontario food and beverage sector is second only to transportation in terms of its contribution to the Ontario economy.
- GDP from food and beverage industries is 13% of that from all manufacturing industries in Ontario.
- Ontario generates 51.2% of the GDP of the total food and beverage industry in Canada.
- In 1996, Ontario's food industry ranked 5th in North America for capital investment and 8th for value of shipments.

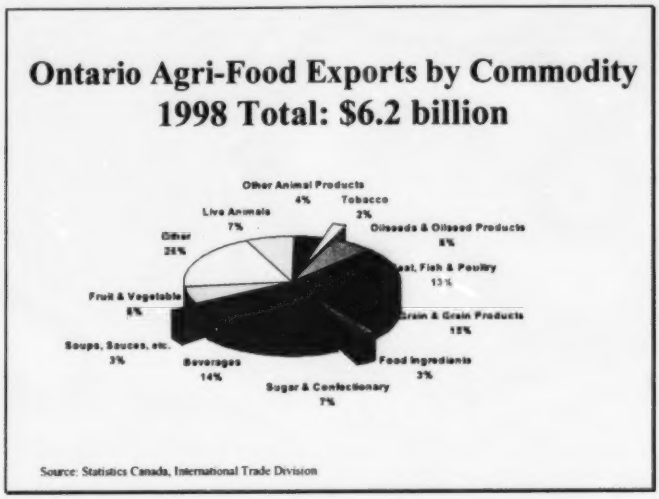
- The total value of shipments from the Ontario food industry in 1997 was 23.4 billion dollars. Meat and meat products accounts for the largest value of shipments (18.9%), followed by beverages (13.4%), dairy (12.5%), fruit and vegetables (9.2%), sugar and confectionery (7.1), bakery (6.3%) and cereal and flour (5.8%).



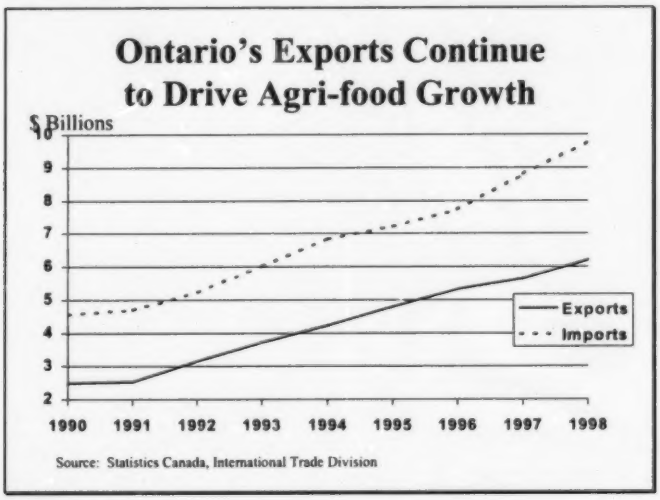
- In 1997, approximately 60% of the value of shipments in Ontario was done by medium sized industry firms (firms with annual sales between $10-200 million), as compared to large sized firms with approximately 31% of the value of shipments and small firms with less than 10%.



1998 Ontario agri-food exports totalled $6.2 billion. Eighty percent of all exports are now value-added, a figure which has increased substantially over the last few years.



- The dollar value of Ontario exports has shown steady growth over the past 10 years but at the same time the value of imports has also increased at a similar rate.



Trends in the food industry in 1999 include:

- Biotechnology and genetically modified foods/organisms (GMO's) have emerged as key issues for the agri-food sector. These topics featured regularly in the media over the last half of 1999 as pro and con forces hotly debated the benefits and risks, which these technologies may present. The adoption of "GMO free" policies among European retailers has implications for the North American industry. In comparison, North American consumer reaction has been slower to emerge, however interest in the

issue is definitely on the increase. Some organizations including McCain Foods of Canada, Heinz and Gerber announced that they would not be using genetically modified ingredients in their products. The Canadian General Standards Board is facilitating a process to develop protocols for voluntary labelling. OMAFRA and a number of client organizations, both at the producer and processor levels, are voting members at that table. The OFPRSC and all three subcommittees spent considerable time at their 1999 meetings discussing the issue and the possible implications for research but were unable to reach concensus on appropriate actions beyond recommending a balanced approach by all parties.

- Demographic forces (dual income families, aging baby boomers, large proportion of working women, single parent families) continue to drive demand for convenience products such as home meal replacements and snack foods in a variety of packaging formats that can maintain freshness and safety. Bagged salads, refrigerated pasta sauce and frozen and refrigerated pizzas were among the fastest growing product categories in 1996-97. Frozen dinners and entrees are the fifth largest grocery category.

- Heightened interest in opportunities to add value to commodities. These opportunities include innovative processing technologies that isolate components for specific functionality traits related to potential use in nutraceuticals, food ingredients, health products and non-food industrial uses.

- Increasing awareness of food safety issues by consumers and industry. Continuing implementation of HACCP as firms recognize the system can dramatically reduce the potential of contamination and improve product quality and consistency. A growing awareness that HACCP will be a requirement for firms that want to take part in the global market. At the present time, the USDA requires that all companies importing meat and poultry products into the United States must have a HACCP program in place and must demonstrate that they can meet U.S. pathogen reduction standards. This requirement may be extended to other sectors such as horticulture in the future. An increase in concern about foodborne illness originating in fruits and vegetables, both fresh and minimally processed, makes food safety an issue that is capturing industry attention beyond the usual meat and meat products sector.

- Continued occurrence of mergers and consolidation in the food industry on a global basis.

- Continuing movement within Canada to harmonize regulations governing nutritional labeling, health claims and nutrient enrichment with the U.S. to foster improved access to larger markets.

- Canada was successfully challenged at the World Trade Organization during 1999 in regards to its' dairy export pricing system. As a result, the dairy industry is taking a look at ways to design a new system for export of dairy products and pricing of exports.

- Decreasing costs, increasing market share and access to export markets remain key objectives for industry.

Further state of the industry information can be found in the appended subcommittee reports.

V. 1999 R & D Priorities

The priorities of the Ontario Food Processing Research and Services Committee can be grouped into two broad priority areas of :

1. Food Safety and Quality
2. Value Added Products and Innovative Technologies

The OFPRSC did not rank these priority areas during their annual meeting, but they have been listed here in an order that reflects the rankings of the subcommittees. The complete lists of priorities for the subcommittees can be found in the subcommittee reports.

1. Food Quality & Safety

Methods for early detection, and reduction/elimination of food safety hazards/contaminants

- Improvement of quality and safety of minimally processed fruits and vegetables and development of protocols for early detection of pathogens and spoilage (Fruit and Vegetable Products and Processing #1a)
- Investigation of process techniques for reduction or elimination of deoxynivalenol (DON, vomitoxin), zearalenone, fumonisins and other mycotoxin components in cereal grains grown in Ontario. (Cereal Grain and Oilseed Products and Processing #2)
- Development of rapid, reproducible methods for detection and quantification of pathogenic *Campylobacter* in meat and poultry. (Meat Products and Processing #2)
- Development of efficient protocols for destruction of pathogens in fruits and vegetables (Fruit and Vegetable Products and Processing #2a)
- Identification and evaluation of intervention strategies for the destruction of pathogenic organisms in meat and meat products. (Meat Products and Processing #3)
- Development of procedure for *E.coli 0157:H7* reduction in uncooked fermented sausages and other ready-to-eat meat products (Meat Products and Processing #4)

Farm to Fork Processes for Ensuring Food Safety

- Development of a risk assessment unit and tools to measure microbial risk assessment. (Meat Products and Processing #1)
- Development of methods to evaluate the effectiveness of HACCP programs at all levels (producer, processor, distributor and retailer) (Meat Products and Processing #5)

Methods to improve the quality and consumer acceptance of Ontario products

- Improvement of the storage, processing and nutritional qualities of fruits and vegetables. (Fruit and Vegetable Products and Processing #1a)
- Investigation of alternatives to the use of chemical improvers in milling and bakery products (Cereal Grains and Oilseed Products and Processing #3)

On-line methods for monitoring and predicting quality during processing

- Development of efficient on-line monitoring procedures for the safety and quality of raw produce and processed products (Fruit and Vegetable Products and Processing #2a)
- Development of on-line methods and technologies for monitoring product quality throughout milling and baking process (Cereal Grain and Oilseed Products and Processing #4)

- Development of rapid, on-line methodology for prediction of carcass end quality (Meat Products and Processing #7)

2. Value-added Products and Innovative Technologies

Methods to enhance the value of Ontario products

- Isolation of value-added natural constituents from Ontario grown oilseeds and cereals and to improve the value of the products produced (Cereal Grain and Oilseed Products and Processing #1)
- Increase the levels of functional food ingredients/nutraceuticals in fruits and vegetables and to achieve increased understanding of their role in human health. (Fruit and Vegetable Products and Processing #1b)
- Exploration of the potential for the development of novel health food products and cosmoceutical products from fruits, vegetables and the waste water generated during processing. (Fruit and Vegetable Products and Processing #1b)
- Exploration of the application of biotechnology in improving fruit and vegetable production (Fruit and Vegetable Products and Processing #2b)

Development of technologies to increase the efficiency of processing and automation of the fruit and vegetable processing industry. (Fruit and Vegetable Products and Processing #2a)

Development and evaluation of processing technologies that will limit the impact of the processing industry on the environment without unduly affecting cost and competitiveness. (Cereal Grain and Oilseed Products and Processing #6)

Investigation of dry milling and heat processing techniques for pulses and legumes to develop flours and meals for products currently imported into Ontario. (Cereal Grains and Oilseeds Products and Processing #6)

VI. 1999 Non-R & D Priorities

Genetically Modified Organisms

OFPRSC supports the production of safe, quality food from a sustained environment. The Committee also supports consumer choice and the availability of comprehensive, unbiased information to encourage informed food-purchasing decisions. The Committee recognizes the benefits of biotechnology, including safe, quality food, improved nutrition, increased agri-food industry productivity, improved environmental stewardship, and advances in the production of pharmaceuticals. OFPRSC supports the use of science to minimize any possible risks associated with new technology. To this end, the Committee supports a strong federal food regulatory system and encourages the continued rigorous efforts of federal agencies to ensure food safety.

Consumer Education

Increased effort toward a consumer education strategy (including high school level) around safety and quality of Ontario grown and processed foods.

- Development of a consumer education strategy regarding food safety issues as a food safety intervention. (Meat Products and Processing)
- Greater effort is put into consumer education regarding the quality and safety of processed cereal grain and oilseed products. (Cereal Grain and Oilseed Products and Processing)

VII. 1999 Recommendations

The priorities outlined in sections V and VI are intended to provide direction for food research programs over the next four years. In prior years these priorities would have been labeled "Recommendations". As a result of changes to the OASCC reporting system in the past year the emphasis is now on identifying priorities for ongoing research. The term "Recommendation" will only be used in situations where the OFPRSC feels that major shifts in resource allocation are needed. Recommendations pointing to major shifts in food research spending are not indicated at this time.

The continuing development of an "agri-food cluster" in Guelph provides opportunities for great synergy as the various players discover new ways to collaborate on projects and initiatives that will address the priorities. No one organization will be likely to address all of the priorities but by working together the various institutions will be able to collectively deliver research that will meet the needs of the agri-food industry. The existing partnership between OMAFRA and the University of Guelph Food Research Program forms a key part of the cluster but there are many other players. The addition of the new Agriculture and Agri-Food Canada laboratory, the development of the Canadian Research Institute for Food Safety (CRIFS) and many recent Canadian Foundation of Innovation (CFI) equipment acquisitions are examples of new resources and capabilities that have come to the food research community in the past year. The Guelph Food Technology Centre, the Health Canada labs and the many University of Guelph departments and industry collaborators that work with the Food Science department provide a great deal of expertise. Other research facilities in Ontario and networks with researchers beyond the provincial borders round out the picture. All together we have a strong and dynamic food research community with the ability to ensure that the priorities identified in this report are met through new and exciting collaborative efforts.

The OFPRSC will continue to monitor the food research being conducted over the next 4 years in Ontario. Annual reports will be produced suggesting minor adjustments to the priorities and recommendations will be produced and circulated if it is deemed that publicly funded programs are failing to address the priorities.

APPENDIX

A. Ontario Food Processing Research & Services Committee Membership 1999

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B. Minutes of 1999 Ontario Food Processing Research and Services Committee Annual Meeting

December 17, 1999

Conference Centre, 1 Stone Road West, Guelph
Members attending: Doug Chapman (Chair), Margaret Treloar (Treloar Product Development), Terry Maurice (Guelph Food Technology Centre), Rickey Yada (U of Guelph), Ken Darley (Griffith Labs), Valerie Davidson (U of Guelph), John Lynch (U of Guelph), Gordon Timbers (AAFC), Susan Read (Health Canada), Don Mercer (AAFC), Jane Graham (Ontario Food Processors Association), Venket Rao (U of Toronto), Patrick Kwan (PMKC International), Levente Diosady (U of Toronto), Stuart Budd (OMAFRA)

Expert Subcommittee Chairs: Gopi Paliyath (U of Guelph), Pat Johnson (OMAFRA), Bill Collins (ECORC/AAFC)

Guests: Bill Ingratta (OMAFRA), Richard Chudyk (OMAFRA), David Brodati (OMAFRA), Ginty Jocius (ARIO)

Regrets: Robert Cummings (Ryerson Polytechnic Institute), Michael Hincks (ORTECH), David Forster (CanAmera), Jim Gordon (Schneiders)

Introductory Remarks

Doug Chapman, OFPRSC chair welcomed the committee members. Brief introductions were shared around the table. The agenda was reviewed with no additions. Doug referred to the contents of the package that was distributed prior to the meeting that included:

- Responses to the 1998 OFPRSC recommendations.
- Current OMAFRA funded food projects.
- Input from several other sources related to priorities for food research.

Doug Chapman briefly commented on the new OMAFRA Healthy Futures for Ontario Agriculture program that was announced by the OMAFRA Minister the day before. This is a 4 year, $90 million program which focuses on Clean Water, Safe Food and New Markets.

Food Processing Industry Overview and Climate

David Brodati, Investment Development Officer with the Food Industry Division of OMAFRA provided an overview presentation on the State of the Food Industry.

Subcommittee Reports

Expert Subcommittee on Fruit and Vegetable Products and Processing

Gopi Paliyath, committee chair reported on the committee meeting. Attendance was lower than hoped for but Gopi has spoken to many of the committee members in preparation for this report.

The committee identified two broad priorities for research, which were (in priority order):

1. Safety and Quality;
2. Development and Evaluation of Novel Technologies.

Several objectives and goals were outlined under each of these priorities. Refer to the committee report for full details. Discussion followed on the topic of GMO crops (potatoes) and the recent announcement by McCains that they would not be using GMO crops. The communication gap between consumers and science was identified as a concern.

Expert Subcommittee on Meat Products and Processing

Pat Johnson, committee chair reported on the committee. Pat has filled in as committee chair for this year but is making efforts to comply with this committee's 1998 suggestion that there be an industry chair. Pat has offered her support to the committee as a secretary in future years.

The committee identified 7 priorities dealing with food safety and quality issues. The issues in priority order were:

1. Microbial Risk assessment
2. *Campylobacter* in meat and poultry.
3. Intervention strategies for destruction of pathogenic organisms.
4. *E.coli* 0157:H7 in uncooked, fermented sausages.
5. Methods to evaluate HACCP at all levels.
6. Evaluation of impact of GMO feeds on meat safety.
7. Rapid on-line methods for carcass end quality prediction.

Refer to the committee report for full details. Once again there was discussion around the GMO issue and questions as to whether the recommendation (#6) related to GMO's was really a research recommendation or a service recommendation related to understanding of the regulatory process.

A non-R&D recommendation related to consumer education was also presented.

Expert Subcommittee on Cereal Grain and Oilseed Products and Processing

Bill Collins, committee chair, presented the committee report. Six areas were identified and prioritized by the committee in the following order:

1. Innovative processing technologies for Ontario grown cereals and oilseeds.
2. Processing techniques for reducing or eliminating mycotoxins.
3. Alternatives to chemical improvers in milling and bakery products.
4. On-line monitoring of product quality during milling and baking.
5. Processing technologies that limit environmental impact without greatly affecting product cost/competitiveness.
6. Dry milling and processing for pulses and legumes.

A further recommendation related to standardized testing for presence or absence of GMO's was presented with the note that the committee had difficulty knowing what to do with this issue.

This committee also presented a non R&D recommendation related to consumer education.

Agriculture and Agri-food Canada Presentation

Don Mercer gave an update on the Southern Crop Protection and Food Research Centre that will be moving into its new facilities at 93 Stone Road West, Guelph in February 2000. Four teams of researchers have been formed as follows:

- Food Preservation Technologies – R. McKellar
- Molecular and Cellular Biology – R. Weedcroft
- Chemical Food Quality – M. Akhtar
- Sustainable Food Quality – P. Wood

University of Guelph Presentation

Valerie Davidson and Rickey Yada shared an update with activities at the University. Valerie will be heading up the 2000-2004 Food Program under the OMAFRA/University Enhanced Partnership. The current proposal is to build the program around three themes of Quality and Safety; Value Added Products and Processing; and Innovative Technologies, Processes and Systems. Ricky discussed some of the new initiatives on campus including the Canadian Research Institute for Food Science (CRIFS) and the Food and Soft Material Science Centre. There are also discussions around the creation of a Food and Health Research Institute at the University, which would incorporate 5 nodes including CRIFS; Food and Soft Materials; Functional Foods/Nutraceutical/Health Products Node; Nutrition/Physical Fitness/Self Care Node; and a Policy and Economics Node.

Open Discussion

Following lunch there was time on the agenda for further discussion of specific issues that had arisen out of the morning's reports.

GMO Issue

Recognizing the difficulty that all three subcommittees had in dealing with the issue of genetically modified foods the chair led a discussion around the issue, the potential research needs being generated by this issue and the committee's stand on the issue. Among the many topics discussed were:

- The need for dissemination of balanced factual information.
- Choice is the key issue for consumers.
- Questions have been raised by some groups about safety and environmental impact.
- Emotional side of the issue.
- Need for a balanced approach similar to the one that OMAFRA has taken.
- Some possible research ideas were put forward however there was not agreement on the usefulness of any of these at the present time.

OFPRSC Priorities

After review of the priorities put forward by the subcommittees the chair proposed that the meeting should spend some time identifying common groupings and discuss ranking those groups. Doug

Chapman, Stuart Budd and David Brodati from OMAFRA would take responsibility for placing the subcommittee recommendations into the specific groupings.
The priority areas agreed upon were:

- Food Safety and Quality
- Value Added Products and Innovative Technologies

Discussion followed around the ranking of these priorities. Agreement was not reached and so the priorities will be presented to OASCC without ranking, however the subcommittee reports that do rank the more specific areas will be attached.

Strategic Vision for Food Processing Research and Development

The 1998 OFPRSC report identified the need for a "vision and strategic business plan for food processing R&D activities". Turnover in the leadership of the OFPRSC in 1999 meant that this need was not addressed. The chair invited discussion on the best method to go about this task in the year ahead. The chair agreed to develop a concept for conducting this planning process and to circulate it to the committee members for their reaction.

Meeting adjourned.

C. 1. Ontario Expert Sub-Committee on Meat Products and Processing Research & Services

Membership:

Pat Johnson, Food Inspection Branch, OMAFRA (Interim Chair)
Pat Dodsworth, Schneider Corporation
Roger Johnson, Health Canada
Joseph Odumeru, University of Guelph Laboratory Services Division
Mike McMorris, Ontario Cattlemen's Association
Conrad Huber, Piller Sausages
Larry Binning, Cold Springs Farm
Wayne Sprung, Maple Leaf Poultry
Gerry Howse, UFL Foods
Ron Usborne, Caravelle Foods
Jim Vidoczy, Ontario Pork
Shai Barbut, University of Guelph
Laurie Murdock, OIMP
Canadian Meat Council

(The Committee thanks John Farlinger of the Food Industry Competitiveness Branch, OMAFRA, for supplying much of the information for the State of the Industry report.)

Subcommittee Activities:

The subcommittee met once during 1999, on November 29. At this meeting members reviewed responses to the research and service recommendations from the previous year. The subcommittee also reviewed the process improvement recommendations from the previous year, and a number of procedures were proposed by OMAFRA for implementation by the committee. Stuart Budd, OMAFRA Research Analyst provided background and advisory information throughout the meeting. Recommendations for future research were reviewed, developed and prioritized by the committee. Non-R&D recommendations were reviewed and developed. One of the strong process improvement recommendations arising from the 1998 meeting was the need for the committee chair to be from industry. To make this possible, OMAFRA needs to provide administrative support. As a result, Pat Johnson from OMAFRA has been appointed Interim Chair until an industry chair can be arranged. Once an industry chair has been appointed, Pat Johnson will assume the role of Executive Secretary to the committee to coordinate and carry out administrative support.

State of the Industry:

OVERVIEW:

- **Inspection cost recovery:** A consultation with the 240 provincially inspected slaughter plants is underway to discuss possible ways of implementing cost recovery (sharing) for inspection. The Ontario Independent Meat Processors, the association representing provincial packers is

challenging ministry attempts to implement cost recovery (sharing). Cost recovery has already been implemented in federally inspected plants, and in some provinces.

- **Food Safety Issues:** Significant changes in the meat sector continue to take place including implementation of food safety measures at the processing level such as implementation of Hazard Analysis Critical Control Point (HACCP) systems and pathogen testing. Food safety issues are of significant concern to consumers. Recent outbreaks of foodborne illnesses and recalls due to pathogens in meat products have an impact on consumer confidence in the food supply. Emerging, rugged pathogens that have the capacity to withstand many traditional processing controls are also of concern to the industry. Food safety, however, is not an issue that is restricted to the processing sector. The safety of meat products and the effectiveness of HACCP programs are impacted by conditions and actions at the production level as well as during distribution, storage, final preparation and service. In addition, little information on risk analysis for meat products is available to allow effective food safety management and control systems, particularly at production and food service levels. The implementation of food safety measures by Canada's major trading partners pressures Canadian processors to follow suit. Food safety standards have emerged as an important issue in international trade, and at the domestic level, the food safety standards practiced by a processor influence buyers, distributors and retailers.

Consumers also have concerns about genetically modified organisms. Therefore this is another issue that may impact the meat trade if consumers decide not to buy GMO products. It is unclear whether the use of GMO feed results in meat being a GMO product.

- **Inter-provincial Trade:** The U.S. is working towards interstate shipment of meat. Since state-inspected plants are now considered to be identical to USDS-inspected plants, this could be a threat if state plants are allowed to ship to Canada. Provincial plants in Canada currently cannot ship inter-provincially. A national system (National Meat Code) is being developed which may result in opportunities for inter-provincial trade.

PORK INDUSTRY

TRENDS:

- **Strategic Partnerships/Alliances/Consolidation:** In 1998-99 there were several large corporate changes in the industry. Value-added processing is still strong and growing.

- **Production Trends:** There is a trend towards bigger farms crowding out smaller producers but there is resistance from municipalities who are concerned with manure management (spills) and want to limit farm size. OMAFRA and the Ministry of the Environment (MOE) are involved in discussions on intensive farming practices and the potential development of provincial standards and regulations for livestock and poultry with respect to manure management and odours. Packers would prefer to deal with a smaller number of producers who have larger volumes.

- **Rationalization and Movement of the Industry to the West:** The two largest players (Schneiders and Maple Leaf) are making significant investments in Western Canada and pork

production in the prairie provinces is rapidly expanding to take advantage of the pacific rim demand for pork.

ISSUES:

- **The 1998 Hog Crisis:** Hog farmers faced financial difficulty as prices reached record lows ($35 per 100/kg) in the winter of 1998 ($100 below cost of production per hog). There have been environmental concerns and attempts to stop or limit intensive hog farming operations, which directly influences the availability of hogs for Ontario packers. There was a shortage of hook space in North America as packers bought up inexpensive hogs. The market crash in Asia and Russia hurt exports. The retail price of pork did not drop. The extra slaughter built up frozen storage stocks, which further depressed prices for farmers.

- **Contracting:** Ontario Pork is proposing a "Supply Management Agreement", which would include Protocols and Procedures for private contracts which have become a very popular sales method for hogs.

- **Availability of U.S. or Quebec Hogs:** The availability of live hogs from Quebec and the US has been an issue for the Ontario hog packing industry. The Quebec Board determines whether hogs are sold to Ontario packers. The countervail issue with the US has been resolved.

- **Weaner and market hog exports:** The growth in weaner exports (585,900 in 1998) has increased rapidly in the last few years leaving fewer hogs to be raised and processed in Ontario. In 1998 1,006,000 markets hogs were also exported from Ontario.

BEEF INDUSTRY

TRENDS:

- **Consumption:** The main growth area in the beef industry in 1998 was in the value-added (kabobs, stir-fry, meatballs, pepper steak) segment which grew by 37.7% in 1998. Canadian domestic retail sales however declined in each quarter of 1998 as the average price per kg increased 9 cents possibly due to pork features. This has turned around in 1999 with a 5% improvement over 1998. The number of households purchasing beef increased to 88.7%. Beef had the largest share of foodservice occasions in 1998. Total per capita consumption increased from 30.6 kg in 1997 to 31.8 kg in 1998.

ISSUES:

- **Industry change:** The industry had continued difficult financial times in 1999. Packers express concern over the number of feeder cattle and veal calves being raised in Ontario. Packers are going to Quebec to buy veal.

- **Veal Grading Changes:** Changes were made to the Veal Grading Regulations and are in place until January 2001. Industry would like the changes to be permanent otherwise the limit may go back to 363 lbs. maximum.

Veal < 363 lbs. will be graded and stamped (hide on)
Veal 363 to 400 lbs. will be paper graded
Veal 400 to 450 lbs. no grading option

POULTRY INDUSTRY

TRENDS:

- **Production and Consumption:** Production increased by 5.8% from 1997 to 1998 and the demand for chicken products continues to grow. Per capita consumption increased 3.6% from 1997 to 26.1 kg per capita and accounts for 28% of all meat consumption. New chicken products and health-conscious consumers have contributed to growth in per capita consumption from 18kg in 1975 to 26kg in 1998. Poultry meat has competitive pricing relative to red meats. Ontario chicken farmers produced 32% of the Canada's supply in 1998 and have a strong processing and marketing advantage over the West. A (national allocation) "bottom-up" agreement was put in place March 1998 to better serve consumer needs. Primary processors have integrated further processing into their operations restricting the available supply for further processors.

ISSUES:

- **Supply Management:** A Farm Products Marketing Commission hearing was held in September, 1999 to improve the system for distributing chicken supply among Ontario processors. The commission allowed concerned industry players to express their views and recommendations. In December, the FPMC rendered a decision on the process for allocating live chicken to Ontario processors, which the commission feels will allow all processors equal access to growth opportunities. The Chicken Farmers of Ontario have been given two months to develop the details necessary to implement the decision. The decision also addressed other issues including the amount of quota for new entrants, a "pricing formula" and changes to the export policy. The decision may be appealed to the Farm Products Appeal Tribunal.

- **Imports:** A NAFTA. ruling allows Canada to retain the right to maintain tariffs on imports of U.S. poultry.

- **WTO:** In March 1999 the Chicken Farmers of Canada and the other four supply-managed commodities (SM5) presented a common position on agricultural trade for the WTO talks. The group feels agreements must establish fair trade and preserve the right of farmers to select the marketing system of their choice.

- **Turkey Quota Allocation:** The Canadian Turkey Marketing Agency (CTMA) export program is being adjusted over the next ten years to reduce re-grow credits for dark meat and increase re-grow credits for white meat. This will have a negative effect on Ontario processors. Ontario quota increased from 122 million lbs. in 1998 to 129.4 million lbs. in 1999. There has been an upward shift in the demand for deli-turkey products and an additional 2 million kilograms request was made for large toms to meet this need. The Canadian quota increased from 228 to

299 million lbs. The quotas will be reviewed when more detail is available on inventories and production.

Research needs and priorities 1999

Research need	Priority
The University of Guelph needs to move quickly to address the gap in the risk assessment area; a recognizable initiative is required and tools to measure microbial risk assessment are needed; the University requires a Risk Assessment Unit to be associated with OAC and the Department of Food Science.	1
Development of rapid, reproducible methods for detection and quantification of pathogenic Campylobacter in meat and poultry	2
Identification and evaluation of intervention strategies for the destruction of pathogenic organisms; Canada is at a competitive disadvantage with U.S. because intervention strategies permitted in U.S. are prohibited in Canada; our legislation is a barrier; legislation needs to be modified to permit intervention strategies that eliminate risk	3
Procedure for E.coli O157:H7 reduction in uncooked fermented sausages and other ready-to-eat meat products	4
Methods to evaluate the effectiveness of HACCP programs at all levels (producer, processor, distributor and retailer) as a means to reduce microbial contamination and pathogenic organisms in meat and meat products; focus must be at all levels, because processor is only part of picture	5
Evaluation of the impact of GMO products for feeding animals on the safety of meat products; consumers need to be made aware of the regulatory process	6
Development of rapid on-line methodology for prediction of carcass end quality	7

Non-R & D Priority 1999

- Development of a consumer education strategy regarding food safety issues as a food safety intervention. The committee identified the need for food safety education at the high school level.

Actions taken on Process Improvement Recommendations from 1998:

1. That Chair and vice-Chair of the subcommittee be industry representatives and that an executive secretary be an OMAFRA employee.

Action: An OMAFRA employee was appointed as an interim subcommittee chair for the 1999 meeting. It is the intention to seek an industry chair, and the OMAFRA employee will become the secretary to the committee. An industry chair has not been located as yet.

2. That there is an increase in research representatives on the subcommittee and that a broad range of organizations be represented.

Action: Additional research representatives have been added to the subcommittee. Increased representation will continue to be sought.

3 That the subcommittee meet every two years and that a major meeting occur every fourth year timed for input into the University of Guelph Food Program review and planning cycle.

Action: The subcommittee may elect to meet every two years. An informal review, perhaps conducted by email, may provide adequate input on the off years. The committee will decide by email discussion whether or not to meet in 2000.

4. That OMAFRA introduce an allotment of funding that can be used to fund emerging high visibility issues requiring research that will balance the longer term research thrusts addressed in the four year planning cycle.

Action: One of the research programs, the Resources Management and Environment program, has identified a number of priorities. It has allocated 85% of its resources to addressing these. The remaining 15% of resources is left open to allow the program to respond to emerging issues that may not have been identified when the 4 year program was put in place, but which have been identified by the annual OASCC process. Development of programs that have the ability to respond to changing needs will be a trend for the future.

5. That the role of the executive secretary staffed by OMAFRA include but not be limited to the following: subcommittee membership, drafting reports, meeting organization, drafting letters from the Chair, setting dates for meetings, providing background information on the OASCC system, and ensuring appropriate linkages of the subcommittee with other groups.

Action: The OMAFRA staff member will provide secretarial functions as described, based on direction from the Chair.

6. That OMAFRA explore mechanisms to ensure that there is accountability of research work to identified research needs and that this feedback be provided in detail to the subcommittee.

Action: The OASCC system is designed to ensure that research work is coordinated with identified research needs. In considering research applications for funding, meeting identified needs is a key consideration. There is always a time delay between identified needs and the funding of appropriate research.

7. That the subcommittee have direct input to the University of Guelph Food Program planning and review with ARIO. That there be links established with the University of Guelph Director of the Food Program, the OMAFRA Director for the Food Program and the Food Program

review committee. That there be representation of the Ontario Food Processing Research and Services committee and its subcommittees on the ARIO planning and review groups for the University of Guelph Food Program.

Action: Appointments to ARIO are done by the Minister. Every attempt is made to have a broad cross-section of interests represented. Links have been established between the Food Processing Research and Services Committee and the University of Guelph.

8. That there be enhanced linkages and communications between the Canadian Agri-Food Research Council and OASCC expert subcommittees

Action: The food research analyst from OMAFRA sits on the Canada Food Committee. The OASCC system also has other formal representations on CARC committees. Other members of OASCC committees and subcommittees are also members of corresponding Canada committees.

9. That OMAFRA subcommittee chairs encourage member advocacy on follow-up to research recommendations

Action: The subcommittee is at liberty to take advocacy action on research recommendations.

Report Submitted by Pat Johnson
Interim Chair
January, 00

C. 2. Ontario Expert Sub-Committee on Fruits and Vegetables, Products and Processing Research and Services

Report of the annual meeting held on 10th November 1999 at OMAFRA, 1 Stone Road, Guelph, Research Priorities for the Period 2000-2004

Executive Summary

The expert sub-committee on fruits and vegetables, products and processing research held its annual meeting on the 10th of November 1999. This meeting was very important and timely in view of the strategic research goals that were to be addressed during the four year period 2000-2004. The Industry Sector was represented by six participants, the Grower Sector by two, the OMAFRA by four and the University of Guelph by three participants. The status of the industry was presented briefly by participating members. After summarizing the research projects under way, detailed discussions were held on the past research and accomplishments in light of which the future research priorities for the period 2000-2004 were proposed. Considering the changing scenario in fruit and vegetable processing industry in particular, and food industry in general, active and fruitful discussions were made in finalizing the research priorities.

INTRODUCTION

The Food Industries based on the fruit and vegetable sector, are major contributors to the economy of Ontario. There is a recent surge in the popularity and consumer demand for fruit and vegetable-based products, home meal replacements, partially-processed fruits and vegetables including ready to eat salads etc. A lot of attention is being given to the disease-preventive and health-restorative roles of fruits and vegetables and the functional food ingredients. If the present trend continues, in the near future, it is likely that there will be Food Industries specializing in products with enhanced levels of functional food ingredients. As well, there is increased attention given to the quality and safety of food products, specifically in relation to genetically modified organisms (GMOs) and food components derived from such organisms. This also brings the issue of food labelling in relation to the origin of food components. These issues are currently being discussed at the Government, Public, Institutional and Industry levels. It appears that the public has not been made fully aware of the process of this technology and the advantages it provides to the consumer. The current opinions are not completely based on the facts and some media have been portraying only the alleged fears regarding GMO products. The commercialization strategies employed by the multinationals have not alleviated any of these fears and results from new studies are shedding more light into several aspects dealing with GMOs. In light of these fears, many fruit and vegetable processing companies have publicly declared their intention not to use GMOs in their products (ex. Baby food products by Gerber, Heinz, Potato fries by McCain). Despite these decisions, research needs to be conducted to evaluate the safety and quality of GMOs to provide the most accurate information to the public. As well, this will lead to defined and strict regulations on the part of the Government regarding the use of GMOs or products derived from them.

Despite several domestic hindrances and severe competition from the Companies in the US, several Canadian Companies continue to produce fruit and vegetable-based products for the Canadian market and export. The size, contribution to GDP and employment in the food industry sector in Ontario is nearly half of that in Canada. In Ontario, food industry is the second largest manufacturing sector, providing nearly 12% of the total manufactured goods. The total value of food and beverage shipments in 1997 was estimated at 23.42 billion dollars. The fruit and vegetable sector contributes nearly 10% to these shipments. The export of processed fruits and vegetables are increasing, however, the import of fruits and vegetables that surpasses export has also been on the rise. On the basis of commodity groups, the trade deficit in fruits and vegetables accounted for nearly 1.4 billion dollars (through August 1999).

The enhanced OMAFRA/ University of Guelph partnership is currently reviewing the research priorities including that of the fruit and vegetable sector. The research programs and goals are set for a strategic period of four years that provide means and guidelines to evaluate the success of the programs. The expert sub committee meeting for fruit and vegetable products and processing research held in Nov 1999, thus made the recommendations on research priorities for the strategic period 2000-2004. The new sub committee is not anticipated to meet annually, but a biennial meeting is planned. There are several new members in the committee and additional membership is required, especially since several past members have decided to discontinue their participation.

STATE OF THE INDUSTRY

The per capita consumption of fruits, vegetables and their processed products are on the rise. According to Statistics Canada, per capita consumption of processed fruits and vegetables in terms of fresh equivalent, has increased 30% since 1971, and is estimated (1997) at around 38.91 kg per capita, one of the highest in the world. Juice consumption has tripled over the period from 1962-96. Per capita consumption of canned and preserved fruit has shown a 46 % decrease. The changing demographics of the population, consumer habits, increasing interest in the nutrition, biotechnology etc. will create further changes that will impact the industry. According to 1997 statistics, in Ontario, there were 65 establishments involved in canning and preservation of fruits and vegetables and 6 establishments in the frozen fruit and vegetable operations. These firms employed nearly 8000 people. In addition, there are several small enterprises involved in partial processing of fruits and vegetables, cider making, processing of organic produce etc.

After the implementation of the Canada-US free trade agreement in 1989, and recently after the NAFTA agreements and increased globalization of trade, the fruit and vegetable processing industry is undergoing adaptive changes. Tariffs on most products that are traded between Canada and the US have been eliminated, and the trade patterns with Mexico is following a similar path. Other agreements under the WTO are also reducing the barriers to trade. Restructuring in the industry has reduced the number of operations, but significantly improved the productivity and competitiveness, with increased number of products targeted towards an export-oriented market, rather than a protected domestic market.

In general, most fruit and vegetable processors operate during the harvest seasons, and production during off-seasons is heavily dependent on imports. The production and quality of most fruits and vegetables in Ontario are similar to that in the US, despite short growing seasons. However, development of technologies to enhance the storage life and quality of fruits and vegetables grown

in Ontario, will reduce the demand for imported fruits and vegetables. For example, increased demand for processed fruit cocktails from Nabisco has caused a simultaneous increase in the demand for Ontario pears and peaches. The company required more than 20,000 tonnes of pears and 15,000 tonnes of peaches per year to meet the demand for processing. However, the production of peaches and pears in Ontario is of the order of 8000 and 5000 tonnes, respectively. The balance is met by imports from the US. Nabisco is currently approaching Growers to switch to peach and pear production. These approaches are extremely healthy for the fruit and vegetable processing industry and the grower sector, and mutual co-operations like this are models to other fruit and vegetable commodities and processors.

There are several firms producing canned and preserved fruits and vegetables, juices and drinks, cider, dehydrated and dried fruits and vegetables, fruit pie filling, baby food, relishes, fruit and vegetable sauces, canned vegetable soups, tomato ketchup, tomato paste, tomato pulp and puree. Several of these are multinational operations, which provide an added advantage for export of the product. A noteworthy example is Heinz Canada. In Canada, Heinz ketchup is reported to hold 65% of the market share. Heinz also introduced five new lines of ethnic-style soups. The sale of bagel bites has increased by 14% in Canada. The demand for processing tomatoes is met by growers in Ontario, the production is similar to that in California. The production of apple juice concentrate needs expansion in Ontario. During 1994-98 period, on the average, 172 million pounds of apples were used in juice making with an average value of 5.38 cents/lb. The processing apples fetched slightly higher price, with 38 million pounds processed, the average price at 12.19 cents/lb. Some creative technologies need to be developed to increase the profit margin for the grower and the processing companies. The recent formation of a producer-based organization (Ontario Sweet Apple cider Association) with the help of Canadian Food Inspection Agency, provides manufacturing guidelines and standards to sweet cider producers. It is estimated that there are currently 115 cider producers in Ontario.

The processing industries that operate in the frozen fruit and vegetable sector are reportedly mostly Canadian-owned. In Ontario, there are reportedly six firms operating in this sector employing in excess of 800 people. Freezing plants utilize a range of products, including both local and imported fruits and vegetables, citrus fruit juice concentrates and ready-to-serve frozen meals. The increase in the export experienced in the frozen fruit and vegetable sector (107 million dollars deficit in 1988, surplus of 249 million in 1997) is primarily due to frozen potato products, to which Ontario's contribution is minimal.

Ontario Food Processors' Association reported stability in their sales with expansions in certain sectors. The pickling industry saw a big expansion with Bick's establishing large scale storage operations for pickled cucumbers in Ontario.

FUTURE TRENDS

With an increase in Canadian population and the increase in the consumption of fruits, vegetables and processed products, there is an anticipated expansion in this sector. The new trends include fruits and vegetables consumed by ethnic population, herbs and spices, that are increasingly grown domestically. There will be increasing competition from outside and effective strategies need to be developed to counterbalance this. For example, apple production in China has been increasing at a rapid rate and apple juice concentrate from China is relatively inexpensive. How far this will affect Ontario's apple processing industry in the future remains to be seen. Better coordination is

required between the production and the processing sector in relation to the demand and supply. Ontario has great potential in expanding its fruit and vegetable production. An objective rapport from the grower organizations and the processing industries are needed (as demonstrated by the initiatives by Nabisco and the Tender Fruit Growers' Marketing Board). The increasing interest among the public on the health regulatory properties of fruits, vegetables and their product needs to be utilized for manufacturing nutraceutical products targeted to the health food market. There are several products available in the market that include drinks and milk made from soybean, cereals, grains etc. There is great room for expansion in this area and companies such as Nabisco and Heinz has targeted nutraceuticals as one of their main research areas. The production of berries such as blueberries, blackberries, cranberries, black currants etc. need to be expanded very much in Ontario, specifically to meet the needs of the nutraceutical market. It is surprising to notice that many growers do not diversify their operations to increase the profit margins. Biotechnology will have a big impact in the future, despite the current objections among the public. Issues on biotechnology are being addressed through the renewed Canadian Biotechnology Strategy proposed by the Government of Canada and several steering committees addressing various aspects surrounding biotechnology issues. The production of value-added ingredients, hormones, vaccines, specialized proteins etc. in fruits and vegetables targeted to the pharmaceutical market, will enable the formation of a new grower/processor industry sector, which will be different from the traditional food producing sectors. Advancements in technology will tend to increase automation, on-line monitoring of product quality and safety, novel technologies to provide more natural products and novel methods to detect and combat pathogens.

Even though the export of processed fruits and vegetables has been increasing, careful planning is needed to keep this area expanding. Most of the export is to the US. However, other International marketing opportunities need to be actively explored. By developing novel technologies for year-round storage of fruits and vegetables, the import of several fruits and vegetables could be reduced. This will lead to a net surplus in the trade balance.

The production of fruits and vegetables organically has been expanding. It is estimated that there are 1800 organic producers across Canada and a section of consumers are willing to pay the higher price for organically grown produce and products. For example tomato juice made from organically grown produce is nearly three times costly than regular produce. This sector is growing at a rate of 10-12% yearly.

The Canadian Agricultural Marketing Council has set an export target of achieving 4% of world agri-food exports by the year 2005. If this target is to be met, it is estimated that the Canadian export of processed food would have to triple by 2005. Most of the growth is anticipated in the food and beverage processing sector. CAMC has made several recommendations to achieve this goal that deals with domestic supply of raw produce, manufacturing capacity, marketing practices and International trade.

STRATEGIC GOALS

A big problem facing the fruit and vegetable processing industries in Ontario is the lack of year-round availability of raw produce grown in Ontario or Canada. Therefore, a large proportion of the fruit and vegetables need to be imported. The cost of fruits and vegetables imported for consumption and processing in Ontario alone can vary between 1.5-2 billion dollars. The growing

season in Canada is limited by a short duration and agricultural operations are not exactly economical by comparison to the South. However, by improving the cultivar varieties and produce quality, it should be possible to eliminate a large chunk of the trade deficit in the fruit and vegetable sector that we are facing today. The research efforts should thus address several of these issues which are listed below.

Supply of the raw produce:

An increased interaction between growers, grower organizations and the processing industries is needed to balance the supply-demand equation. We have representatives of the grower and marketing organizations participating in the meetings to look into such issues.

1) Improving long-term storage conditions is another means of assuring year-round availability of the produce. For this, we have to develop cultivars that yield produce better-suited for storage. Such produce will also have better quality that will be ideal for its use in processing.

Improving processing and packaging techniques:

1) Development of novel varieties with reduced degradative reactions are needed. This could be achieved by increasing the natural levels of antioxidants and antioxidant enzyme systems. As well, the levels and activities of degradative enzymes and enzymes that generate free radicals could be reduced. Such modifications will help to preserve the natural quality of the produce during processing, especially in fresh-cut products and ready-to-eat preparations.
2) The use of appropriate processing and packaging technology is essential to preserve the quality and reduce contamination by pathogens during storage and marketing.

Fruit and Vegetable consumption and human health:

1) There is increasing awareness and interest on the role of functional food ingredients and health among the consumers. In the future, products with specific and enhanced functional food values need to be developed.
2) We have to know the mechanism of action of various functional food ingredients to substantiate various claims on the disease-preventive and health- restorative roles of fruits and vegetables as well as nutraceutical products derived from it.

Fruits and Vegetables as sources of value-added ingredients:

1) Through genetic engineering techniques, fruits and vegetables can be programmed to produce high levels of antioxidants, hormones, enzymes, sweeteners, essential oils etc. Such produce could be used as industrial sources for the isolation of special ingredients.
2) Fruit- and vegetable waste generated during processing could be used to isolate value-added ingredients targeted to health products market.

Development of novel technologies:

1) Incorporation of modern technologies and automation will help the processing sector tremendously. These include automated on-line processing and on-line quality monitoring (colour, texture, flavour, composition etc.).

2) Developments of trend-setting products based on fruits, vegetables and the wastes generated during processing will provide new directions to these sectors. Because of the lack of demand, during some seasons, fresh produce market is flooded with raw produce, which reduces the market value of fresh fruits and vegetables. Unfortunately, the processing sector does not have a diversified production program that limits the utilization of excess, relatively inexpensive fresh produce. Development of novel food products will tremendously help the grower and industry sector alike.

RESEARCH PROJECTS

There are several research projects supported through the U of G/OMAFRA Food Program that address the above issues, funded through the 96-2000 period. Some of these are listed below.

1. Controlled atmosphere storage and modified atmosphere packaging of fruits; Chu, C.G.
2. Identification and analysis of Ontario garlic varieties yielding value-added nutraceuticals; Holub, B.J.
3. Supercritical extraction of lycopene from tomato skins; Kakuda, Y.
4. Improvement of quality of dried tomato by application of osmotic dehydration as pretreatment; LeMaguer, M.
5. Non-thermal pasteurization of fruit juices by high voltage electrical pulse treatment; Mittal, G.S.
6. Food-derived phytochemicals and components in human health and nutrition; Paliyath, G.
7. Improving structure and properties of fruit- and vegetable-derived processed food by regulating the activities of undesirable and detrimental reactions; Paliyath,G.
8. Melatonin biosynthesis in fruits and vegetables; Paliyath,G.
9. Extracting aromas and flavours using supercritical carbon dioxide; Goldman, S.
10. Rapid and quantitative detection of spoilage organisms and foodborne pathogens in ready-to-use vegetables; Schraft, H.
11. Detection of parasites and pathogenic bacteria in fruits by PCR; Schraft, H.
12. Factors regulating the processability of Ontario-grown potatoes; Yada, R.Y.
13. Glycoalkaloid content in potatoes; Yada, R.Y.

OMAFRA- Special research Program:

1. Biochemicals from corn: developing a biochemical industry based on corn in Ontario; Hough, K.
2. Development and application of a combined thermal-chemical process to extend the shelf life of ready-to-use lettuce and assessment of spoilage by electronic nose technology and culture method; Odumeru, J.
3. Effective communication of risks, benefits and risk analysis of genetically-engineered food in Ontario: The case of Bt sweet corn; Powell,D.

Research Priorities

1. Fruit and Vegetable Quality and Safety :

Ontario imports large amounts of fruits and vegetables for processing and edible purposes. The trade deficit in this sector amounts to nearly 1.7 billion dollars in Ontario. Even though the imports of citrus fruits and bananas that cannot be grown in Ontario profitably are unavoidable, a large number of fruits and vegetables can be grown in Ontario during the growing season and stored for further use. However, the present methods of storage have to be considerably improved to achieve year-round storage capability. This objective cannot be achieved by simply storing the produce under different controlled-atmosphere conditions. Judicious and targeted approaches involving both basic and applied research are necessary to achieve this goal. As a long-term goal, development of ideal varieties that can be subjected to long-term storage could be achieved through genetic engineering. Also, an important consideration in a successful storage programme is the retention of flavour and taste characteristics of the fresh produce. Therefore, this research is an endeavour to optimise the requirements of adequate shelf life extension and quality retention.

Fruits and vegetables are subject to rapid degradation. In general, the physiological function of the produce has been achieved and the system is programmed to undergo degradation and senescence. Our objectives are to maintain the properties and qualities of such systems by artificial means, through the use of chemicals and controlled atmosphere storage. In the case of minimally processed fruits and vegetables, wounding the system causes enhanced degradation through the loss of compartmentation and making the products more susceptible to pathogen attack. Regulation of the degradative reactions is the key to enhance shelf life and quality of fruits and vegetables. We will have to address the issues of regulating enzymatic degradation through safe chemical means or by developing new varieties with regulated deterioration, through genetic engineering. Early detection of pathogens is an important aspect in the quality and safety of minimally processed fruits and vegetables. Novel techniques for monitoring pathogens (ex. PCR, Electronic nose etc.) are important in this regard. As well, appropriate treatment, packaging and storage regimes have to be designed for minimally processed fruits and vegetables.

The quality of fresh, minimally processed and processed fruits and vegetables are becoming important issues to the health-conscious public. Recent trends show that the functional food and nutraceutical market is growing at a rapid pace, with several companies introducing products fortified with vitamins, minerals and phytochemicals. This trend is a result of increasing consumer awareness on the role of consuming fruits and vegetables and their ingredients in improving human health. As well, several epidemiological studies support this contention. More focused studies need to be conducted to understand the precise mechanisms of nutraceutical action. We are conducting such studies at University of Guelph, and these studies will help the Food Industry in Ontario to compete in the domestic, as well as in the U.S. market. There are several other beneficial constituents in edible plant species. These agricultural resources could be used for industrial-scale isolation of important constituents. Identification and purification technology of highly potent nutraceuticals or enzymes will require closer collaboration among the researchers from several different disciplines such as food science, food technology, organic chemistry, pharmacology and nutritional science, which is currently under way.

The quality of the processed product depends on the excellence in quality of the raw material. There are several features that have to be taken into consideration while evaluating currently used fruit and vegetable varieties. Many of these varieties are selected for growing under ideal weather conditions. The climatic factors affect the growth, productivity and quality of fruits and vegetables. The weather conditions in Ontario are subject to rapid fluctuations and the plants are subject to chilling, heat, drought, flooding etc. all during the same season. Many of the varieties that are currently grown in Ontario are not stress-tolerant. In the long-term, development of stress-tolerant varieties will be ideal. Indirect evidences suggest that stress-tolerant plants also produce fruits and vegetables that show high organoleptic, storage and processing qualities.
The following are the specific recommendations made by the committee.

1a) Objective: To improve the storage, processing and nutritional quality of fruits and vegetables:

I. To maintain properties and qualities of harvested produce, making them amenable to year-round storage and ensuring availability for the fresh market and the processing industries.
II. To improve the quality and safety of minimally processed fruits and vegetables.
III. Development of protocols for prediction of quality including early detection of pathogens and spoilage.

1b) Objective: To increase the levels of functional food ingredients/nutraceuticals in fruits and vegetables and to achieve increased understanding of their role in human health:

I. To study the biosynthesis of functional food ingredients/nutraceuticals and develop techniques to enhance their levels.
II. To achieve increased understanding on the biochemical and molecular mechanisms of action of health-regulatory components in fruits and vegetables.
III. To explore the potential for the development of novel health food products and cosmoceutical products from fruits, vegetables and the wastes generated during processing.

2. Development and Evaluation of Novel Technologies:

Fruit and vegetable processing methods are constantly subject to changes and improvement for producing high quality products. The increase in automation will increase the productivity and therefore lower the cost of production. On-line determination of quality of the raw produce, removal of parts that are not processed etc. need to be addressed. Novel technologies for destruction of pathogens in processed foods also are an important area. The use of Electronic Nose technology, DNA-chip technology, Plasmon Resonance Technology etc. could be of use in several aspects of fruit and vegetable processing.

A serious threat to the fruit and vegetable production and the processing sector alike, is the increasing competition from foreign countries where the production costs are lower. This, and other local factors such as production volume, drives the price of raw and processed products in Ontario, downwards. In the long run, this can negatively affect the productivity and competitiveness of Ontario fruit and vegetable production and the processing sector. A means of combating this problem is to diversify the products developed from fruits and vegetables and efficiently utilize the wastes generated during processing. Value-added products and formulations targeted to the functional foods, nutraceutical and cosmoceutical market could be developed that have an ever-

increasing demand in Canada, the USA and Europe. This will ensure a healthy fruit and vegetable sector in Ontario.

Biotechnology is increasingly becoming a part of life in Canada, and the Canadian Government has set objectives and goals for the expansion of Biotechnology to make it into a viable industry. Biotechnology is considered as the next sector that will develop and generate wealth in Canada, and with a strong infrastructure in Animal and Plant Agriculture, Food and Medicine, it is only a matter of time before Canada attains an important place among Biotech countries. With over 50% of these sectors concentrated in Ontario, proper attention and representation should be provided in the research sector. The public needs to be educated as to the true nature of genetically engineered produce and the potential benefits resulting from these. Biotech approaches involving genetic engineering will tremendously increase the pace of new product development. Already, research into the production of fruits and vegetables with enhanced quality and shelf life, increased vitamin and nutraceutical content and other potential value -added ingredients, is being conducted. With appropriate labelling laws, public will have a choice and knowledge to evaluate the biotech products that are currently in the market and that are being introduced.

2a) Objective: To develop more efficient technologies in processing and automation for improving fruit and vegetable processing industry:

I. To increase the productivity and efficiency in processing lines.
II. To develop efficient on-line monitoring procedures for the safety and quality of the raw produce and the processed products.
III. To develop efficient protocols for destruction of pathogens.

2b) Objective: To explore the application of biotechnology in improving fruit and vegetable production, quality and processing:

I. Development of genetically- modified fruits and vegetables tailored for the needs of the processing industry and evaluation of the quality and safety of raw produce and processed products.
II. To explore the development of novel value-added products in fruits and vegetables for use in food and health products.

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C. 3. ONTARIO EXPERT SUB-COMMITTEE ON CEREAL GRAINS AND OILSEEDS PRODUCTS AND PROCESSING,

1999 REPORT TO ONTARIO FOOD PROCESSING RESEARCH AND SERVICES COMMITTEE, DECEMBER 17, 1999 BY F.W. COLLINS

EXECUTIVE SUMMARY

The Annual Report of the **EXPERT SUB-COMMITTEE ON CEREAL GRAINS AND OILSEEDS PRODUCTS AND PROCESSING** outlines 6 R & D recommendations to ARIO and AAFC. Within the terms of reference of the Sub-Committee, 2 recommendations address the need for new and innovative processing technologies for adding value to the cereal and oilseed sectors. One deals with environmental issues associated with food processing and manufacture, while another emphasizes the replacement of synthetic dough conditioners. A further 2 recommendations address quality control needs in the baking industry and techniques for both pulse and legume milling and processing. One general Non-R & D recommendation for continued consumer education has been directed to CARC and CC. In addition, for lack of a consensus on the proper placement of one of the recommendations (GMO's) the Chair has decided to include it as a "Special Recommendation".

These recommendations have arisen through Committee consensus and are for the most part the result of an initial evaluation of the "state of the industry", prepared in the fall of 1997. An updated overview covering more recent issues has been included which summarizes the size, scope, problems, needs, opportunities, and changes perceived to be important to these sectors. A new "ranking system" for the recommendations was requested by OASCC this year and the Sub-Committee has responded by averaging individual ranking orders privately submitted to the Chair following in-depth discussion of each recommendation in committee.

A summary of the activities of the Sub-Committee, its terms of reference, and its membership are included.

INTRODUCTION

This report covers the period December 1998 to December 1999 of the activities and recommendations of the Ontario Expert Sub-Committee on Cereal Grains and Oilseeds Products and Processing ECCOPP. The Sub-Committee represents the cereal grain processing and manufacturing sectors of the Ontario agricultural economy in terms of research and development issues related primarily to the wheat, oats, and corn commodities which are the principal sources of raw materials for a number of processing and manufacturing industries including milling and baking, breakfast cereal and food ingredient manufacture. The Sub-Committee also represents the oilseed processing and products sectors including those associated with vegetable fats and oils, primarily derived from corn and soya, margarine and other oilseed-derived ingredient manufacturers, and processors/manufacturers of foods and food ingredients from pulses and legumes.

The Sub-Committee has reviewed the previously established R & D recommendations, re-evaluated their priority status and modified the recommendations by consensus approval. It has also

considered Non R & D aspects of the grains and oilseed sector and approved one broad recommendation.

The report includes state of the industry overviews for the 1998 year, and emerging needs of the sectors as discussed in committee and as relayed to the Chair of the Committee from a number of sources. Although the final numbers for farm gate receipts and total production are from last year, the major issues remain remarkably similar. Due to restrictions of time, a review of the state of the industry is not possible each and every year. It will be reviewed again in 2001. A summary of the minutes of the Annual Meeting in November is included.

COMMITTEE ACTIVITIES

MEETINGS:

Minutes of the Annual Meeting, Ontario Expert Sub-Committee on Cereal Grains and Oilseeds Products and Processing

November 17th, 1999, Robin Hood Multifoods Technical Centre, Etobicoke, ON

Attendance: Ms. Susan Abel, Mr. Robert Bryson (OMAFRA), Mr. Stuart Budd (OMAFRA), Dr. F. W. Collins (Chair), Dr. L. Diosady, Dr. J. Michaelides and Dr. P. Wood.
Absence: Mr. David Forster and Mr. Quentin Johnson

1. The chair welcomed all the members, the new members, Dr. Peter Wood of AAFC and Ms. Susan Abele of Weetabix as well as Mr. Stuart Budd and Mr. Robert Bryson of OMAFRA

2. The minutes of last annual sub - committee meeting were approved.

3. Mr. Stuart Budd Research Analyst with OMAFRA Education, Research and Laboratories Division presented the various changes in the OMAFRA Food Research Program and what is expected of the various sub - committees. A lengthy discussion followed in order to clarify the various points presented by Mr. S. Budd.
The following points were discussed:

A) A four-year food research program will be in the planning stages by the new head of the program Valerie Davidson. This will be presented in April 2000 and probably will be approved in June.

B) The general committee has requested that the recommendations put forward by the sub - committee is prioritized using a single numbering system rather than the previous system This will rank the recommendations according to a vertical priority list. This will result with the sub - committee being responsible for the ranking of research areas that will be funded. The non-research recommendations will be prioritized separately. The recommendations then will be

evaluated based on all the recommendations of the entire sub - committees and certain changes will be implemented. Some major points discussed regarding this request are summarized below.

– The increased responsibility for the sub-committee. There is a need for better representation from the industry. However industry will not participate in such committees unless they see some long or short term benefits from the process. The role of the sub - committees are carried out on a volunteered basis and therefore if work load and responsibilities increase there should be supported by some funding.

– The definition of the horizon of the research area recommendations should be clarified: Should we be looking at short or long term areas of research ? The role of the sub - committee is to address issues related to the grains and oilseeds. In order to come up with meaningful recommendations the relation of the recommendations to the marked size of the particular area should be known. Mr. Robert Bryson of OMAFRA Food Industry Competitiveness Branch offered to provide that information prior to prioritizing the selected recommendations.

– It was mentioned that the feedback coming to the sub - committee from OMAFRA as to which recommendations were funded and the types of projects supported was not adequate to help us review the existing recommendations and propose new ones. There is a need to improve it. It should be identified why work in certain recommended areas has not been carried out. I t was suggested that a representative of OMAFRA be present at all sub - committee meetings.

– The reporting of the recommendations to the main committee and type written report was discussed. A format for the presentation of the report is available but this may be lengthy and cumbersome and needs to improve.

C) Following these discussions the old recommendations were reviewed briefly and a new recommendation was suggested by Dr. L. Diosady:

New Recommendation: Recommend the development of standardized testing for all cereals and oilseeds of importance to Ontario food product formulations for the presence or absence of GMO.

The process of prioritization of the recommendations was initiated but however due to the limited time available it was decided that the members of the sub - committee prioritize the eight research recommendations (7 from last year and 1 new) at their own time and send the results to the chair (F. W. Collins) to prepare the appropriate report to the general committee.

John Michaelides
November 30 1999

STATE OF THE INDUSTRY

CEREAL GRAINS

A. Wheat in Ontario:

The estimated wheat crop in Ontario for 1997 is expected to show gains over last year with significant increases in quality and yield, due in part to less downgrading due to *Fusarium* infestation. Overall quality was grade #2 with total production of all types of wheat approximately 750,000 tonnes. Some downgrade to feed was expected as a result of dwarf bunt (*Tilletia controversa)* and *Fusarium* problems. The individual crop production for the major types are summarized below:

Type	Estimated volume	Total fg return
white wheat	372,000 tonnes @ $155-170/t	$58-63 million
red winter	140,000 tonnes @ $155-170/t	$22-24 million
red spring	64,000 tonnes @ $160-175/t	$10-11 million
soft red	162,000 tonnes @ $155-170/t	$25-28 million

This represents a farm gate value (not including premiums or common and feed grade returns) of between $115 and $126 million. Applying an end product value factor of 10 fold (which considers the processing and product value added to the commodity), this represents a contribution of over $1 billion to the Ontario economy. Major end uses for Ontario wheat include flour milling for bread and baking, gluten production, cereal and pasta manufacture and distilled spirits. Competitive issues for the products and processing sectors include:

- Mycotoxin contamination and disease-related yield reductions and downgrading raising commodity (i.e. raw material costs) as well as food and feed safety issues for domestic consumption and export of products. Following a somewhat disasterous year in 1996, the mycotoxin outlook is relatively good this year. However, the problem has not gone away (recall experiences in the early 80's) and solutions must be found if stability in the sector is to be strengthened.

- Quality control/quality assurance in the processing and manufacture of finished products. Enormous losses can be encurred in production costs if quality control at each step in the rather complex process of controlling milling, conditioning, formulating, leavening, baking and stabilizing the products is only poorly understood from a scientific standpoint. Searches for natural replacements for currently used synthetic oxidizers and anti-staling ingredients have once again presented new production variables into this equation.

- Opportunities exist for adding value to the crop through innovative processing technologies that more efficiently separate, fractionate and isolate components of the grain for specific functionality traits especially those related to their potential use in cosmetic and health care products, neutraceuticals, food ingredients and renewable energy resource development.

B. Corn, Barley and Oats in Ontario:

By far, the most important of these three cereal crops is corn, with approximately 1.5 million tonnes consumed in industrial and food processing in 1996. Total farm gate value in 1995 approached $500 million in Ontario. Barley production for 1995 in Ontario reached 418,000 tonnes of which 90 % was used as feed. Total farm gate value in 1995 was probably close to $150 million but since many producers grow their own barley for livestock feed and farm-to-farm sales, these estimates are probably not taken into account in annual value statistics for the crop. Ontario totally depends on Western Canadian Barley for the malting sector (1995) requirements of 120,000 tonnes. Similarly for oats, statistics are clouded due to on-farm production and utilization, and much of the food and industrial requirements for oat cereal and ingredient manufacture is satisfied from Western Canadian producers.

Competitive issues are grouped together for these three cereals as follows:

- Except for oats, disease issues continue to factor into both availability and end use products and processing, and alternative-processing technologies for these cereals as described for wheat above should be seriously considered. Processing for oat and barley soluble fibre (β-glucan) and better utilization of processing wastes may represent examples worth pursuing.

- Ontario has ample marginal land which is suitable for the production of oats and perhaps utilization of some of the newer high protein naked oat and barley varieties in these areas close to food processing and production facilities, may represent an opportunity for adding value to these crops.

OILSEEDS

A. Soya in Ontario:

-1995 - 75 million bushels
-1997 - 85 million bushels
-1999 - 83 million bushels

1998 Total crop cash value = $ 592 million at farm gate for 98
or ≈$ 1.81 billion total value of the crop

Major competitive issues for the Ontario soya crushing industry in 1999.

Crush margins for the 1999/2000 crop for soya and canola in Ontario are such that soya is expected to be preferentially crushed during the year. This will create a situation where Ontario beans will be insufficient to meet the Ontario supply. USA beans will be imported to satisfy the supply deficiency. The USA soya farmers are receiving a subsidy of about 1$ per bushel. Because of this, USA beans can be delivered to Ontario at cost lower than that for Ontario beans.

GMO issues continue to be the major problem that the industry is facing. Farmers are uncertain as to whether they should be planting GMO varieties or non-GMO varieties. And should they plant non-GMO varieties, should they plant Identity Preserved crops to maximize their selling price. But currently, the demand for these different groups of beans is largely unknown.

There is some export for crusher beans, but this market will go to non-GMO beans.

The quality of the Ontario soybeans is good. They are higher in protein and oil than normal.

Other Issues

4. Interest in the use of value added soya protein products are growing. Currently Ontario is doing little in regards to manufacturing such products.
5. Interest in the extraction and isolation of minor compounds from soybeans is growing very quickly. Again, Ontario is currently doing little in regards to producing such products.
6. The use of "soya milk" is growing in many countries, including Canada. Ontario has an unfortunate restriction on the use of the name "Soya Milk" for this product.
7. There has been no growth in Ontario of the production of modified oilseed varieties with specific fatty acid profiles. One variety of modified soybeans has been commercialized in the USA.
8. The emergence of mandatory *trans* labeling in the USA (and probably Canada) during the next 1-3 years is expected to result in a demand for a high stability soybean oil.

SpecialtySoybeans:

This segment of the crop remains strong, with a major component being exported. Breeding work continues to improve of the quality of protein, sugar, starch, and pectin in specialty beans for tofu, miso, natto, and soya milks. There is an increasing interest for the use of these in Ontario for the manufacture of vegetarian and health orientated soy based products.

B. Canola in Ontario:

The 1997 crop was 2.5 million bushels. In 1999, the crop was 2.2 million bushels. The growing of canola in Ontario has suffered for several reasons: lack of viable winter canola varieties, increases in the heat units in Ontario, and the relatively high cost of growing canola compared to that for soya and wheat.

C. Corn in Ontario:

The major areas of interest in Ontario corn processing is in the production of corn starch, high fructose corn syrups and ethanol. Ontario no longer produces corn oil. Canada's corn oil requirements are now filled from the US.

Corn oil was once regarded as perhaps the most nutritious oil in the market because of it's high content of polyunsaturates. But corn oil's high level of polyunsaturates is now overshadowed by the fact that this oil has a higher level of saturates than many consumers will accept.

REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS.

A report entitled "Responses to 1997 Recommendations of the Ontario Food Processing Research and Services Committee" dated December 1998, was received by the Chair on December 7th. Included in this package was a listing of projects (titles only) and durations of research which are receiving funding through OMAFRA/University of Guelph Food Research Program. The Chair welcomes these responses directed to the Sub-Committee by ARIO, AAFC (Guelph), and Office of Research, University of Guelph. However, as evident in the minutes of the Sub-Committee last September, this information would have been extremely valuable and closely considered at our meeting if it had been forwarded to us before the meeting. Copies of these documents have been forwarded to the Sub-Committee members for consideration at next years meeting. Since in a totally voluntary Sub-Committee it is often difficult to schedule meetings at short notice, and commitments of time, travel and participation especially from NGO representatives are hard to obtain, it would be perhaps better if the responses were made available to the Chairs at an earlier date. Our Sub-Committee has been meeting in the second or third week of September for at least the last eight or nine years to allow sufficient time to prepare the Annual Report. If we are to remain current and responsive, this lag time between recommendations and responses must be reduced. Perhaps such information could be put on a web site with notification to the Chairs when it will be available.

A copy of the notes from the OASCC Executive Committee meeting of June 26, 1998 was also received on December 7th. by the Chair. To some extent a number of the issues raised at our annual Sub-Committee meetings had been addressed but due to timing were not available to us for discussion.

The Chair received a copy of a draft, dated Sept 4th, of a planning session summary from the meeting of Aug. 26th, Ontario Wheat Producers' Marketing Board, prepared by Jayeff Partners management consultants. In this draft, a number of recommendations were made concerning *Fusarium* resistance, skilled scientific expertise, and on-line wheat flour performance monitoring. It is perhaps somewhat rewarding to this Sub-Committee to see an independent, facilitated "think tank" has remarkably similar views as to R & D priorities in one of the areas mandated to our Sub-Committee.

SUMMARY OF DISTRIBUTION OF RECOMMENDATIONS

	To Agencies					
Recommendation	**AAFC**	**ARIO**	**CC**	**CARC**	**OMAFRA**	**OTHER**
1. Cereal and Oilseed value-added process technologies	X	X				
2. Amelioration of grain mycotoxin levels	X	X				
3. Alternatives to chemical improvers	X	X				
4. On-line monitoring of milling quality	X	X				
5. Dry Milling of pulses and legumes	X	X				
6. Alternate processing and the environment	X	X				
1. Education on product safety and quality			X	X	X	

DETAILED RECOMMENDATIONS

ONTARIO EXPERT SUB-COMMITTEE ON GRAINS AND OILSEEDS PRODUCTS AND PROCESSING

RANKED R & D RECOMMENDATION #1

TO: AGRICULTURE AND AGRI-FOOD CANADA, EASTERN REGION

AND TO: AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

TITLE:

Recommend that innovative process technologies are developed for the isolation of value-added natural constituents from Ontario grown oilseeds and cereals, and to improve the value of the products produced. For example, technologies could be developed for the isolation of valuable natural constituents during oilseed processing, the value of oilseed products could be enhanced by improving their nutritive properties or natural constituents could be recovered from cereal milling fractions with nutraceutical applications.

DETAILS:

1) To apply novel or innovative processes which would allow for the isolation and purification of naturally occurring cereal and oilseed components that would serve as a source of ingredients for the manufacture of other products.

2) To identify or develop novel applications for Ontario cereal and oilseed products that would enhance the value of these products. There is a potential for value-added applications of cereal and oilseed products for food, nutraceutical, industrial, and feed uses.

3) To identify emerging and/or innovative processes for the production of nutraceuticals from cereal grains including soluble fibre concentrates, anticarcinogens, antioxidants, preservatives, saponins, cardioprotectants and multifunctional medium-chain glycerides. To develop analytical methodologies for the quantitative evaluation of targeted nutraceuticals and related products with defined functionalities such as antioxidant hydroxycinnamates, anticancer lignans and flavonoids and hypocholesterolemic β-glucans.

BACKGROUND:

Conversion of raw agricultural commodities into value-added foods and food ingredients is becoming an area where the contribution of new and innovative food engineering and processing will be hard to overestimate. Adding value to Ontario cereal and oilseed commodities will not only capture the benefit to economic output but also will also provide employment and generate government revenues. Recent increased consumer awareness of and demand for bioactive constituents of functional foods and food ingredients that either affect the nutritional properties of

foods, or have physiological benefits once consumed, has stimulated scientific interest because of the roles these substances may play in disease prevention. Thus, further benefits through reduced health care costs may also be realized in the longer term. Efforts should be made to support fundamental research into the physiological functionality of these bioactive components including animal and, eventually, human feeding trials, since establishment of a role and value will enhance efforts to devise innovative process technology and novel product formulation.

A number of oilseed components have been shown to have nutritive and/or neutraceutical value. Innovative extraction and separation technologies such as membrane filtration, supercritical fluid extraction and microwave-assisted extraction have been suggested as alternative methods for the isolation and recovery of sensitive constituents or for the removal of undesirable products from otherwise problematic matrices. Naturally occurring constituents such as isoflavones, antioxidants, pharmaceutical precursors, saponins and phytosterols have known or reported functionalities in food and non-food applications.

More research is needed to apply innovative technologies to explore the potential of these and other extraction and separation concepts and their utilization in the recovery of cereal and oilseed components for food and non-food uses.

There is a need for research that will allow the Ontario industry to improve the current oilseed oil and meal processing technologies to meet the needs of the health-conscious consumer, for example by reducing or eliminating such components as *trans* isomers, by the preservation of natural antioxidants and the recovery and use of valuable minor constituents such as tocopherols, phytosterols, saponins and isoflavones. Since, to a certain extent, improvements have been driven by establishment of health benefits, support for partnering between production, processing, manufacturing, academic, clinical and government sectors to establish biological activity/end use applications, such as health maintenance and disease prevention/management, should be encouraged.

Innovative processing technologies might improve the nutritive value of oilseed meal products for human and domestic animals (fish, pigs, poultry, cattle, and pets). Such improvements would extent the domestic and export markets for protein and protein products for uses either as a food or food ingredient. Other innovative processes could result in increased levels of natural phenolic antioxidants, vitamins, carotenoids, or phytosterols being retained in either refined corn, soya or canola oils.

Clearly, cost-effective production and utilization of natural emulsifiers, antimicrobials, antioxidants, and nutraceuticals is going to be critical to the success of value-added foods from cereal grains and oilseeds. Ontario must take initiatives to affirm its leadership in fundamental and applied research, in partnership with industry, academia, and the health care sectors, on new and innovative technologies for its cereal crops.

RANKED R & D RECOMMENDATION #2

TO: AGRICULTURE AND AGRI-FOOD CANADA, EASTERN REGION

AND TO: AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

TITLE:

Recommend that process techniques be investigated for the reduction or elimination of deoxynivalenol (DON, vomitoxin), zearalenone, fumonisins and other mycotoxin components in cereal grains grown in Ontario.

DETAILS:

1) To develop a process which will allow for the removal of *Fusarium* mold damage from Ontario grown Soft Winter Wheat and other grains.

2) The level of removal to be substantial so that reduction in DON and other mycotoxins results in flours which are considered safe for human consumption.

BACKGROUND:

The unprecedented and extensive *Fusarium* damage and DON content of the 1996 Ontario Soft Winter Wheat crop caused shortages in availability for domestic use. The *Fusarium* damage is a recurring phenomenon in Ontario-grown wheat forcing millers to bring in US wheat or Western Canadian wheat. The extent of the damage can be gauged by the estimates released by the Ontario Wheat Marketing Board: only 137,000 MT of wheat from the 1996 crop of ~940,000 MT had acceptable levels of mycotoxin for human consumption.

Wheat breeders are working on developing *Fusarium*-resistant wheat but it has been a long and difficult task. It is known that *Fusarium* has the capacity to produce toxic levels of mycotoxins, which can affect the health of consumers of the cereals. The fungal mycelia and its potential to produce toxins first attacks the hilum (germ terminus) and can readily spread throughout the bran layers to the underlying endosperm (flour). Exploring dry milling techniques such as preprocessing to selectively remove the outer layers of the kernel may substantially reduce the levels of mycotoxins in the remaining grain. There may be other techniques, which need to be explored to obtain the desirable reductions.

RANKED R & D RECOMMENDATION #3

TO: AGRICULTURE AND AGRI-FOOD CANADA, EASTERN REGION

AND TO: AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

TITLE:

Recommend that a search be investigated to seek for alternatives to the use of chemical improvers in milling and bakery products.

DETAILS:

1) To search for natural oxidants or oxidation-inducing enzymes which will replace the currently used chemical improvers (oxidizers).

2) To develop processes which will allow production of bakery goods free of any chemical improvers but with the traditionally established quality attributes of the final product.

3) To adjust the parameters of the new process so that they will in no way adversely affect its efficiency with respect to labour requirements, processing time and cost of the final product.

4) To focus the development of an analytical methodology for detecting the disallowed chemical improvers and for a quantitative monitoring of their replacers.

BACKGROUND:

For decades, a number of chemical improvers (oxidizers) have been used by Canadian millers and bakers to improve not only the colour of the end product, as often perceived by the consumer, but primarily to compensate for inconsistencies in the processing quality of flour due to various factors (grain variety, climate location, etc.), and to meet the quality requirements for a specific process or type of end product.

More recently, the use of these improvers has been of considerable concern to the increasingly health conscious consumer who prefers the use of fewer chemicals. However, the use of the improvers can only be discontinued without any disruptive interference with the existing manufacturing practices and structure of the baking industry, if suitable alternatives are offered to the processor.

In looking for an alternative, two approaches are basically considered: the use of a natural ingredient or enzyme which will induce an identical type of oxidative reaction that is required for the development of the desired qualities; or the use of a technological process which will yield an improved-free final product with qualities identical to those of the currently available products.

RANKED R & D RECOMMENDATION #4

TO: AGRICULTURE AND AGRI-FOOD CANADA, EASTERN REGION

AND TO: AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

TITLE:

Recommend that on-line methods and technologies for monitoring and controlling product quality throughout the milling and baking process be developed.

DETAILS:

1) To develop an on-line measure of quality, at the various stages of the milling and baking.

2) To correlate quality parameters to down-stream-processing requirements for better control of final product quality.

3) To develop instrumentation for in-process milling to predict final flour quality.

4) To correlate dough quality to formulation and make-up conditions so that continuous adjustments to the process can be made.

BACKGROUND:

Milling is still considered an art, although technological improvements have been made. Control of various stages in the milling is by the "feel" of the miller. The final flour quality depends upon the control at initial stages. On-line instruments to measure the parameters at the early stage will go a long way in controlling the final flour quality. In the bread making process the time from when the dough is made up until the finished product is wrapped can range from 1½ to 8 hours. If product quality problems are not detected until the end of the process, thousands of loaves could conceivably have been produced with the quality defect. A method of predicting final product quality will allow adjustments to be made to the process in earlier stages.

On-line measurement from early stages in milling to final flour quality and then the measure of dough quality as well as control on fermentation and baking processes will reduce losses of finished product. Production of flour and baked goods at competitive prices will increase export potential and thus contribute to economic advancements for Ontario.

RANKED R & D RECOMMENDATION #5

TO: AGRICULTURE AND AGRI-FOOD CANADA, EASTERN REGION

AND TO: AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

TITLE:

Recommend that techniques for the dry milling and heat processing of pulses and legumes are investigated to develop flours and coarse meals for use in foods currently being imported into Ontario.

DETAILS:

1) To develop techniques which will process pulses and legumes into flours and meals, which allow for the high recovery of flours from the raw material without adversely affecting the nutritive value of the processed materials.

2) To modify the process to allow for flours and meals to be precooked so that they can be used by consumers without additional processing.

3) To replace flours and meals made from imported pulses and legumes with Ontario-grown material.

4) To develop a milling and processing program in Ontario to utilize pulses and legumes which are starting to be grown in Canada and thus provide an added-value product available for both domestic and export markets.

BACKGROUND:

The number of new Canadians who originate from regions of the world such as Latin and South America, Africa, East and SouthEast Asia and the Mediterranean region has grown significantly over the past twenty years. They have brought with them their own food customs and individual dietary needs. Their traditional sources of protein and carbohydrates are very often pulses and legumes such as lentils, beans, peas and chickpeas rather than meat- and cereal-based sources. Currently these pulses and legumes are being imported into Canada as both raw and as processed meals and flours. In addition, as part of the crop diversification programs in Western Canada, many of these pulses and legumes are being bred and developed for commercial crop production in the west.

It is well known that so-called ethnic foods once they have been introduced into Canada become widely accepted by the general population and form part of the Canadian diet. The potential for a growing Canadian market of processed pulses and legumes is seen to exist. Research initiatives in this area will prove beneficial for Ontario. Recommend that on-line methods and technologies for monitoring and controlling product quality throughout the milling and baking process be developed.

RANKED R & D RECOMMENDATION #6

TO: AGRICULTURE AND AGRI-FOOD CANADA, EASTERN REGION

AND TO: AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

TITLE:

Recommend that development and evaluation be made of emerging/alternative processing technologies which limit the impact of the cereal food and feed industry in Ontario on the environment without unduly affecting the cost/competitiveness of the products.

DETAILS:

1) To characterize co-products, wastes and/or air-water emissions generated at all stages of cereal production and processing.

2) To devise means to reduce, recycle and recover quantities of by-products generated including, for example, fermentation/fuel ethanol production from cereal starch/milling by-products.

3) To develop rapid analytical methods for starting materials to finished products and co-products for the presence of desirable and undesirable substances.

BACKGROUND:

In keeping with today's heightened environmental awareness, research into the performance characteristics of emerging/alternative processing technologies will be critical to providing efficient use of natural resources. Research is needed at almost every stage of cereal food processing and manufacturing to minimize "waste" through alternate practices and constructive utilization of co-products into edible food, feed, fuel and agrochemical. Concomitantly a clear picture is needed of the precise qualitative and quantitative composition of co-products and wastes, and of any unique functionality they may posses.

Ways of conserving, recovering, reconditioning and recycling the water used in cereal food and ingredient manufacturing will also be required to lessen the burden of the industry on Ontario's water supplies. Further research is needed in the application of alternative processing such as supercritical fluid extraction, membrane separation technologies, cryogenic distillation, and environmentally less harmful cleaning agents and sanitizers to reduce emissions of chemical solvents and reagents. These research requirements will accentuate the fundamental need for more energy-efficient processes for extracting, drying, mixing, separating, refining or otherwise manipulating cereal grain raw materials and will greatly contribute to the sustainability of the environment in Ontario.

UNRANKED SPECIAL RECOMMENDATION

TO: CANADIAN AGRICULTURAL RESEARCH COUNCIL

AND TO: CANADIAN AGRICULTURAL SERVICES COORDINATING COMMITTEE and the ONTARIO AGRICULTURAL SERVICES COORDINATING COMMITTEE

TITLE:

Recommend the development of standardized testing for the presence or absence of GMO's in all cereals and oilseeds of importance to Ontario food product formulation

DETAILS:

1) To develop processes to detect GMO's at the ***input*** level before the product is formulated.

2) To coordinate research with national (CFIA) and provincial standards and directives to harmonize methods (i.e. like an AOAC standard method).

BACKGROUND:

A number of issues concerning Genetically Modified Organisms(GMO's) in raw ingredients for Ontario food processing and finished products have emerged in the last year in response to heightened consumer awareness. Cereal and oilseed processors have faced production problems and increased costs in the segregation of processing and manufacturing feed stocks. Further difficulties in the assurance of source materials, ingredients and formulation/processing aids with respect to their GMO content has resulted in lost exports, especially to European markets. Lack of clear definitions, monitoring, and regulatory policy has also lead to labelling and compliance difficulties. These problems are not restricted to Ontario agriculture but clearly involve all players in the Canadian Agri-Food sector.

While clearly a national policy on GMO's in processed agricultural products is needed, attempts to develop testing capabilities which will detect GMO components entering the processing stream, rather than after the product is manufactured, are needed to enable manufacturers to make, if necessary, self-regulatory decisions. Such testing may help in the short term but leads to eventual confusion and misinformation without proper harmonization with an overall plan. The recommendation therefore is not so much an R & D as to restrict its directive to purely analytical expertise. Rather the recommendation is meant as a wake-up call to gather resources to tackle a multifaceted emerging issue of increasing importance to the success of the sector.

NON-R & D RECOMMENDATION #1

TO: CANADIAN AGRICULTURAL RESEARCH COUNCIL

AND TO: CANADIAN AGRICULTURAL SERVICES COORDINATING COMMITTEE and the ONTARIO AGRICULTURAL SERVICES COORDINATING COMMITTEE

TITLE:

Recommend that a greater effort is put into consumer's education regarding the quality and safety of processed cereal grain and oilseed products.

DETAILS:

1) To inform consumers objectively on health risks and benefits associated with the consumption of processed cereal and oilseed products.

2) To change the unjustifiable negative attitudes of the consumer towards some current manufacturing practices of the cereal and oilseed processing industries.

3) To provide consumers with information that will allow proper understanding of health claims, organic food claims, nutritional and warning labelling of food products.

4) To dispel false myths and misconceptions spread by the media in connection with nutritional and safety aspects concerning processed foods.

BACKGROUND:

Despite great concern about the safety and nutritional qualities of processed cereal and oilseed products, the average consumer is not equipped with a sufficient knowledge to approach these issues on a rational level. His/her attitudes are based in most cases on information disseminated by mass media that by resorting to sensational journalism create a host of misconceptions and unjustified fears. At the same time, some manufacturers may be tempted to use these misconceptions to lure the consumer into choosing products to which various unproven claims have been attached.

Consumers should be made aware of the risk-benefit concept. They should be educated to understand that man-made "chemicals" are not the only, and not necessarily the major cause for concern, and that more serious health hazards may arise from the presence of natural toxins in our food or toxins resulting from microbial activity. An integrated approach should be taken whenever the issue of food safety is being discussed instead of focusing on isolated topics.

APPENDIX

ONTARIO EXPERT SUB-COMMITTEE ON GRAINS AND OILSEEDS PRODUCTS AND PROCESSING

Terms of Reference of the Committee

The Ontario Expert Sub-Committee on Grains and Oilseeds Products and Processing operates under the following terms of reference:

- To meet at least once a year to review current and emerging needs of food processors, manufacturers and distributors in the cereal grains and oilseed sectors of the Ontario Region for both research and development, and for non-research and development issues.

- To review existing recommendations, establish new recommendations and assign or update priorities to these recommendations.

- To submit a report to the Ontario Agricultural Services Coordinating Committee and the Food Processing Research Services Coordinating Committee containing :
    - a summary of the Committee's activities;
    - summaries of the state of the industries and their emerging needs;
    - actions taken on the previous year's recommendations;
    - detailed recommendation descriptions, backgrounds, and priority ratings for each recommendation.

- To respond to requests from the parent Committee and from participants from the sectors represented as required.

APPENDIX

ONTARIO EXPERT SUB-COMMITTEE ON GRAINS AND OILSEEDS PRODUCTS AND PROCESSING

Membership:

Position, (Representation), Appointment date	Affiliation	Contact
F. William Collins Chair (Federal Government) 1997-	E.C.O.R.C. Agriculture and Agri-Food Canada K.W. Neatby Bldg., C.E.F. Ottawa, ON K1A 0C6	Phone: (613) 759-1715 Fax: (613) 759-1701 E-mail: collinsb@em.agr.ca
Levente Diosady Member (University)	Department of Chemical Engineering University of Toronto 200 College St., Toronto, ON M5S 3E5	Phone: (416) 978-4137 Fax: (416) 978-8605 E-mail: diosady@chem-eng.toronto.edu
David Forster Vice-Chair (Industry) 1997-	CanAmera Foods 30 Weston Rd., Toronto, ON M6N 3P4	Phone: (416) 761-4175 Fax: (416) 761-4452 E-mail: canamera.research@sympatico.ca
Quentin Johnson Member (Industry)	Quican Resources RR #4 Rockwood, ON N0B 2K0	Phone: (519) 856-2364 Fax: (519) 856-1101 E-mail: quentin@quican.com
John Michaelides Vice-Chair (Industry) 1998-	Robin Hood Multifoods Inc. 191 Attwell Drive, Unit 4 Etobicoke, ON M9W 5Z2	Phone: (416) 675-2541x236 Fax: (416) 675-6194 E-mail: john.michaelides@robinhood.ca
Susan Abel Member (Industry) 1999-	Weetabix of Canada Ltd. Northam Industrial Park Cobourg, Ontario K9A 5P5	Phone: (905) 372-5441 E-mail: willy@eagle.ca
Peter Wood Member (Federal Government) 1999-	S.C.P.F.R.C., Agriculture and Agri-Food Canada, 43 McGilvray St.,c/o U of Guelph, Guelph ON N1G 2W1	Phone: (519) 767-5077 Fax: (519) 837-9472 E-mail: woodp@em.agr.ca

D. Summary of Other Data Gathered in Preparation for the OFPRSC Strategic Report

The Ontario Food Processing Research and Services Committee relies on the knowledge and networks represented by its Expert Subcommittees to determine the priorities outlined in this report. This year, in preparation for the 4 year Strategic Report, further input was sought. The information gathered was consistent with the reports of the Expert Subcommittees and was shared with the OFPRSC membership. This is a summary of the input gathered.

July/August 1999 – The Food Industry Competitiveness Branch of OMAFRA distributed a survey among its client groups (Ontario food industry businesses) seeking their thoughts on food research priorities. 27 food processing companies completed the survey. A number of similar themes emerged including:

- Novel, value-added products and processes
- Reduction of preservatives, chemicals in processed foods
- Increased shelf life
- Food safety – pathogens, allergens
- Reduction of costs

September 1999 – In conjunction with the Food Science At Work conference organized by the University of Guelph Food Science department, OMAFRA organized a session titled "Leadership in Food Research". Approximately 65 people representing a cross section of industry, government, university faculty and students participated in table group discussions on the question "How/Where do we position publicly funded food research over the next 4 years?". Some common responses were:

- Leading edge, long term research – both basic and applied
- Food quality and safety, health aspects of food
- Implications of technology
- Ontario must compete globally
- Communication with consumers is key

November 1999 – Representatives of food related organizations were invited to attend an open meeting about priorities for publicly funded food research. Although attendance was low the participants who did come represented some sectors which are not well represented at the Expert Subcommittee level. These included the Dairy and Food Service sectors. Food safety was the top priority expressed at this meeting including pathogen detection and reduction, "gate to plate" safety, and the need for consumer information. Other items discussed included value added products, health benefits of foods and management of food wastes.

November 1999 – The Canada Committee on Food is a committee of the Canadian Agri-Food Research Council (CARC). The annual meeting of this group was held in Ottawa and food research issues of national importance were discussed. The major themes emerging from the meeting were shared with OFPRSC members and included:

- Food safety issues
- Health aspects of food – labelling, nutraceuticals
- Processing technologies
- Genetically modified foods

December 1999 – The Ontario Dairy Council conducted a survey of its membership as part of an initiative to fill a Dairy Technology Research Chair at the University of Guelph. The survey asked members to identify key research areas. The responses included:

- Health aspects, nutraceutical uses
- Novel uses for dairy products
- Increased shelf life
- Rapid tests for pathogen detection

December 1999 – The Food Engineering Subcommittee of the Ontario Agriculture and Food Engineering Research and Services Committee presented its report. While this committee is not a part of OFPRSC, the recommendations of the committee are certainly pertinent. The committee presented 7 recommendations that were:

1. Improved technologies for pasteurization such as non-thermal processes to reduce processing cost and to enhance nutritional and flavour quality, and shelf life.
2. Baking and frying processes modeling to improve baked and fried products' quality.
3. Image processing for inexpensive in-line methods for detection of glass pieces in glass containers, chicken bones in mechanically deboned chicken and sclerotia (black fungus) in beans.
4. Development of efficient methods for separation, purification and concentration of nutraceuticals from various sources (soybean, tomato, hemp, etc.)
5. In-line sensors for microbial detection, moisture at high temperature for baked foods and dough properties.
6. Raw material characterization for food product quality.
7. Optimizing material handling in wine industry.

E. Summary Of Distribution of 1999 Priorities

The list of the 1999 priorities will be distributed to the following organizations requesting their response and an indication of their activity in these areas.

- Agriculture and Agri-Food Canada
- Health Canada
- Canadian Agri-Food Research Council
- Canada Committee on Food
- Ontario Ministry of Agriculture, Food and Rural Affairs
- University of Guelph

Commodity specific priorities may also be referred to specific organizations by the subcommittees.

F. University of Guelph Food Research Projects With Funding through the OMAFRA/University of Guelph Enhanced Partnership Agreement 1999-2000

Project Name	Research Leader	Start/End Date
Rapid and quantitative detection of spoilage organisms and foodborne pathogens in ready-to-use vegetables	H. Schraft	1997-2000
Detection of parasites and pathogenic bacteria in fruits by PCR	H. Schraft	1997-2000
Microbial ecology of biofilms in pork and beef processing facilities	H. Schraft	1997-2000
Identification and analysis of Ontario garlic varieties yielding value-added nutraceuticals	J.B. Holub	1997-2000
Improvement of quality of dried tomato by application of osmotic dehydration as pretreatment	M. LeMaguer	1997-2000
Modeling of the osmotic dehydration unit operation for industrial application	M. LeMaguer	1997-2000
Integration of food quality sensors with robotic actuators	H. Swatland	1997-2000
Physio-chemical and functional properties of polysaccharide stabilizers when used in frozen foods: improving frozen food stability	D. Goff	1997-2000
Protein phase diagrams	R.W. Lencki	1997-2000
Modification of fat and oil texture by physical and chemical methods	A.G. Marangoni	1997-2000
Nutraceutical application for dietary plant oils in promoting development of immune competence in the young	D. Woodward	1997-2000
Software and sensors for improved control of food processes	V.J. Davidson	1997-2000
Factors regulating the processability of Ontario-grown potatoes	R.Y. Yada	1997-2000
Food-derived phytochemicals and components in human health and nutrition	G. Paliyath	1997-2000
Improving structure and properties of fruit and vegetable-derived processed food by regulating activities of undesirable and detrimental reactions	G. Paliyath	1997-2000
Melatonin biosynthesis in fruits and vegetables	G. Paliyath	1997-2000
Value-added utilization of hens egg yolk immunoglobulin for passive immunization for human rotavirus infection	Y. Mine	1997-2000
Non-thermal pasteurization of fruit juices by high voltage electrical pulses	G.S. Mittal	1997-2000
Structure-function of food related proteins: aspartic proteinases	R.Y. Yada	1997-2000
Value-added product recovery using supercritical fluids	W. Stiver	1998-2000
Extracting aromas and flavours using supercritical carbon dioxide	S. Goldman	1997-2001
Naked Oats – Potential use in food products.	S. Rose	1999-2002
Supercritical extraction of Lycopene from tomato skins.	Y. Kakuda	1999-2002
Controlled atmosphere storage and modified atmosphere packaging of fruits.	CG Chu	1998-2001
DHA Milk	A.Hill	1999-2001
Preparation of food samples for chemical analysis in Health Canada's "The Market Basket Study".	C. Tracy	1999-2003

G. Report of Action Taken on Previous Year's Recommendations

Summary of Responses to R&D Recommendations in 1999

The 1998 recommendations were distributed to organizations for comment in 1999. The responses to each of these recommendations are listed in italics under each recommendation.

A. Value-added Products and Processing

1. Develop innovative process technologies for the isolation of value-added natural constituents from Ontario grown oilseeds and cereals, and to improve the value of the products produced.

Agricultural Research Institute of Ontario
This recommendation was included as one of five objectives for the value-added food component of the Special Research Program, a competitive research fund initiated by OMAFRA in 1998-99. Through this program, two research projects related to cereal grains and oilseeds will be funded. The funding will support scale up processing of a newly developed technology which incorporates non-hydrogenated liquid oils into plastic fats to produce a margarine with no trans fatty acids and relatively low saturates. Another project will look at the potential for using antifreeze proteins from winter cereals to improve the quality and shelf life of frozen beef and other frozen foods.

Agriculture and Agri-Food Canada, Greg Poushinsky
A cereal scientist recently joined the staff of the Food Research Program, Guelph. He is in the process of developing his research program. The proposal will be discussed with representatives of the millers, bakers and growers to ensure relevance to Ontario priorities. The Food Research Program has committed to support the sectors with an additional food scientist, to be hired this year.
The Food Research Program, Guelph, has major initiatives underway (up to 7 scientists) in the area of value-added through the identification of components, their characterization, extraction, purification, and assessment of bioavailability and bioactivity. These activities include both the fractionation of raw crops and the use of existing waste materials as sources of phytochemicals.

2. Study techniques for shelf-life extension of fresh and minimally processed fruits and vegetables.

3. Develop alternative uses of fruits and vegetables so that the most valuable constituents such as nutraceuticals or proteins are processed.

4. Support of research activities to create new value-added meat products with emphasis on further processing.

Agricultural Research Institute of Ontario

This recommendation was included as one of five objectives in the value-added component of the Special Research Program, a competitive research fund initiated by OMAFRA in 1998-99. Through this program two research projects will be funded which relate to meat. Research will be conducted to develop a model and computer program, which describes the survival of E. coli 0157:H7 in meat during the manufacture of, fermented sausage. If successful, the research will enable meat processors to comply with new stringent U.S. policies in a cost-effective manner.

Lacombe Research Centre, Dr. D.R.C. Bailey

It is recognized that this recommendation has an emphasis on further processing and it is agreed that increased production of value-added meat products is essential to the growth of the meat industry. This area of research is limited to a few centres such as Saskatchewan Food Product Innovation Program, AAFRD Leduc Food Processing Centre and AAFC St. Hyacinthe.

We have programs at Lacombe designed to increase the value of lower quality cuts on the carcass, to improve tenderness and some work has been done on marinades. Researchers at the University of Alberta are also combining biopreservatives with marinades to improve the value of beef cuts.

The Lacombe Research Centre in association with Food Science Department of the University of Manitoba is investigating methods of using master packs with oxygen-depleted atmospheres for the preservation of retail-ready chilled, raw meat products.

Retailers recognize there are substantial economic advantages to be gained by preparing fresh meat in retail-ready forms at central locations, with distribution of the finished product to retail stores, rather than preparing retail packs at each store. However, attempts to implement central preparation have been successful only in areas where a central facility can be placed close to one or more large centres of population, so that retail-ready product can be delivered speedily and frequently to many stores.

That situation arises because of the limited storage/display stability of meat in the crude preservative packing systems that are used by the meat industry coupled with sub-optimal control of product temperatures. It has been demonstrated that oxygen-depleted atmospheres can be used to give retail ready product an adequate display life after several weeks of storage. Work is currently in progress to refine the form of the master packing system for retail ready meat, and to develop a cryogenic container to maintain product at the optimum temperature during the transport to and storage at retail outlets of retail ready meat.

Food Science Dept., University of Guelph, Dr. Rickey Yada

Industry has scraped the bottom of the barrel trying to develop new value-added products. Too much emphasis on totally new - which means difficult to sell. Better

strategy would be optimization of conventional processed products, i.e., research on continuous processing, sensors and control software. New products per se should be in the area of nutraceuticals - in Japan I saw a whole range of great products produced from slaughter-house waste (iron, improved alcohol tolerance, "fast" energy, etc.)

Very important and as stated here "new jobs will be created". Fully supported.

Canadian Meat Council, Carla Abbatemarco

Creation of value-added products.
We recommend this research area be more detailed and specific; it is too broad in scope. Work is already being conducted in this very general area.

Agriculture and Agri-Food Canada, Greg Poushinsky

Existing research in the area of rheology (development of molecular level understanding of stabilizers; application to processed meats) and microbial control will continue at the Food Research Program. This expertise is applicable in the area of value-added meat products, but product development activity will depend on finding a partner with specific needs.

B. <u>Food Quality & Safety</u>

1. Process techniques should be investigated for the reduction or elimination of deoxynivalenol (vomitoxin) and zearalenone in cereal grains grown in Ontario.

Agricultural Research Institute of Ontario

The ARIO recognizes the need for research in this area. Currently, there are no projects which address these recommendations being funded through the OMAFRA/University of Guelph food research program. A major reason for this is the lack of expertise at the University of Guelph. The Ontario Wheat Producers' Marketing Board (OWPMB) is planning to initiate a campaign in the upcoming months to raise funding to support the creation of a chair in cereal technology at the University of Guelph. OMAFRA has been working with the OWPMB and the University of Guelph on this initiative. The creation of a research chair in cereal technology will enable strategic research to be conducted which will benefit the cereal industry.

Agriculture and Agri-Food Canada, Greg Poushinsky

A cereal scientist recently joined the staff of the Food Research Program, Guelph. He is in the process of developing his research program. The proposal will be discussed with representatives of the millers, bakers and growers to ensure relevance to Ontario priorities. The Food Research Program has committed to support the sectors with an additional food scientist, to be hired this year.

2. Alternates to the use of chemical improvers in milling and bakery products.

Agricultural Research Institute of Ontario
The ARIO recognizes the need for research in this area. Currently, there are no projects which address these recommendations being funded through the OMAFRA/University of Guelph food research program. A major reason for this is the lack of expertise at the University of Guelph. The Ontario Wheat Producers' Marketing Board (OWPMB) is planning to initiate a campaign in the upcoming months to raise funding to support the creation of a chair in cereal technology at the University of Guelph. OMAFRA has been working with the OWPMB and the University of Guelph on this initiative. The creation of a research chair in cereal technology will enable strategic research to be conducted which will benefit the cereal industry.

Agriculture and Agri-Food Canada, Greg Poushinsky
A cereal scientist recently joined the staff of the Food Research Program, Guelph. He is in the process of developing his research program. The proposal will be discussed with representatives of the millers, bakers and growers to ensure relevance to Ontario priorities. The Food Research Program has committed to support the sectors with an additional food scientist, to be hired this year.

3. **Determine chemical, physical, nutritional and sensory quality parameters of Ontario-grown fruit and vegetable varieties for processing.**

4. **Develop a risk assessment model to evaluate the health risks associated with the preparation and sale of refrigerated, uncured, cooked meat products under different packaging environments.**

Agriculture and Agri-Food Canada, Greg Poushinsky
No development of specific Risk Models is planned. However, the ongoing development of bacterial population growth models will support Risk Model development by others.

OMAFRA Education Research and Labs Division, Dr. Bruce McNab
My comments remain essentially the same as last year. Although I am not certain of the current or expected market share of these products, I can see their continued potential, and I strongly agree that research in this area is needed. Ideally, food safety research dollars across food types should be prioritized roughly proportional to risk and uncertainty. There remains considerable uncertainty in this area, given our lack of experience; some of that uncertainty might be addressed by systematic research. This might allow at least some of the information gaps to be filled. This would facilitate better assessment of risks. Health Canada in Guelph does have a good safety risk assessment unit that could be asked to work on this problem. Also, the Food Science Department of the U of G should be encouraged to bring more graduate students on line to systematically obtain data and then organize that data in formal risk assessments. The skills they learn could be applied to these and other risk assessments needed in food safety.

5. Verification of systems for evaluation of HACCP program intervention strategies.

Lacombe Research Centre, Dr. D.R.C. Bailey

The verification procedures currently employed for HACCP systems do not objectively identify the microbiological effects of the processes or operations to which they are applied. A general procedure for assessing the hygienic performances of meat production operations or processes from small quantities of microbiological data has been developed. The procedure has been applied to a number of commercial processes. Those studies have shown that current HACCP systems, which are based in the subjective assessment of visible contamination, are wholly inadequate for controlling the microbiological condition of meat. They have also shown that interventions such as washing, trimming and vacuuming with or without application of steam or hot water are generally ineffective for removing bacteria from carcasses; that chilling processes can be operated to reduce the numbers of E. coli on carcasses; and the E. coli on primal cuts and manufacturing beef are derived mainly from improperly cleaned carcass breaking equipment. It is then evident that the microbiological effects of meat production operations and processes are commonly misunderstood by those seeking to control them, and that current HACCP systems at meat packing and processing plants are doing little to assure the safety of meat.

Food Science Dept., University of Guelph, Dr. Rickey Yada,

HACCP plans widely in place using good logic, etc. Unfortunately, most of the data are faked. TOP PRIORITY should be development of on-line procedures (data log sensors) and software for spotting forged data. There has been significant new research in accounting computer science enabling even quite small fake data sets to be identified.

Agree. This is not so much new research but more of an applied research.

Health Canada, Dr. Susan Read

Thank you for providing input to us on priorities for food safety research. I will be pleased to bring these priorities to the attention of our research scientists this fall as we plan projects for next year. With respect to R&D recommendation #4, a major thrust of our research program is on-farm intervention strategies to reduce food borne pathogens entering processing plants. We have had several projects funded this year and in the past addressing this issue. I would be pleased to send you a list of our current research projects.

C. Innovative Technologies, Processes & Systems

1. Techniques for the dry milling and heat processing of pulses and legumes be investigated to develop flours and coarse meals for use in food currently being imported into Ontario.

Agricultural Research Institute of Ontario
As stated in previous responses, the ARIO recognizes that there is some opportunity in this growing niche market for the production and processing of pulse and legume flours in Ontario. However, due to limited research budgets the ARIO will continue to recommend that funding be directed towards addressing the research priorities identified for the major milling crops.

Agriculture and Agri-Food Canada, Greg Poushinsky
No work in dry milling and heat processing of pulses and legumes is planned at the present time.

2. Development and evaluation of emerging/alternative processing technologies which limit the impact of the cereal food and feed industry in Ontario on the environment without unduly affecting cost/competitiveness of the product.

Agricultural Research Institute of Ontario
The ARIO agrees with the need for research in this area. The OMAFRA/University of Guelph food program includes goal 3.4 "Engineering analysis of waste streams to identify recycling opportunities and valuable component recovery potential in food processing plants". Due to budget limitations in 1999-2000, no projects have been funded which address this recommendation. Industry funding will be necessary to conduct research in this area.

Agriculture and Agri-Food Canada, Greg Poushinsky
A cereal scientist recently joined the staff of the Food Research Program, Guelph. He is in the process of developing his research program. The proposal will be discussed with representatives of the millers, bakers and growers to ensure relevance to Ontario priorities. The Food Research Program has committed to support the sectors with an additional food scientist, to be hired this year.

3. Development of on-line methods and technologies for monitoring and controlling product quality throughout the milling and baking process.

Agricultural Research Institute of Ontario
The ARIO recognizes the need for research in this area. Currently, there are no projects which address these recommendations being funded through the OMAFRA/University of Guelph food research program. A major reason for this is the lack of expertise at the University of Guelph. The Ontario Wheat Producers' Marketing Board (OWPMB) is planning to initiate a campaign in the upcoming months to raise funding to support the creation of a chair in cereal technology at the University of

Guelph. OMAFRA has been working with the OWPMB and the University of Guelph on this initiative. The creation of a research chair in cereal technology will enable strategic research to be conducted which will benefit the cereal industry.

Agriculture and Agri-Food Canada, Greg Poushinsky
A cereal scientist recently joined the staff of the Food Research Program, Guelph. He is in the process of developing his research program. The proposal will be discussed with representatives of the millers, bakers and growers to ensure relevance to Ontario priorities. The Food Research Program has committed to support the sectors with an additional food scientist, to be hired this year.

4. **Develop and encourage application research to adopt appropriate engineering technology to the fruit and vegetable processing industry.**

5. **Develop preservation methods that are compatible with all fruit and vegetable varieties and will maximize sensory and nutritional qualities of these varieties.**

6. **To support research aimed at investigating methods and procedures for *E.coli* O157 reduction in uncooked fermented sausages.**

Lacombe Research Centre, Dr. D.R.C. Bailey
The Lacombe Research Centre does not engage in research on processed meats as such, and therefore is undertaking no research on the destruction of E. coli 0157:H7 during fermentation and drying of sausages. However, researchers at the Centre have established that most of the E. coli found on raw meat, including that used for manufacturing sausages, are deposited on the product during the breaking down of carcasses. The source of those E. coli, which can include E. coli 0157:H7, is improperly cleaned equipment used in carcass breaking processes. Work is therefore in progress to identify the equipment involved in contamination of product, with a view to the development of procedures for assuring the proper cleaning of those types of equipment. In addition, the pasteurizing of manufacturing meat is being investigated, and an apparatus for pasteurizing manufacturing meat is being designed. Studies to date indicate that pasteurizing treatments can be applied to meat to reduce E. coli to undetectable numbers without affecting the functional or organoleptic properties of comminuted or processed meats prepared from the pasteurized product.

It is suggested that the preparation of fermented sausages from meat that is assuredly free of enteric pathogens is preferable to attempting their assured destruction during fermentation processes.

Canadian Meat Council, Carla Abbatemarco
The CMC Technical Committee supports this area. Some research work is currently in progress.

Agriculture and Agri-Food Canada, Greg Poushinsky

The Food Research Program has little research in the areas of meat and meat products. However Ecoli control in general is a focus of some of the program. The work to be carried out, coupled with other hurdle technology investigations, and basic work proceeding in developing automated quantitative PCR will be applicable to this research recommendation.

D. Waste Management Processes and Systems

1. Develop methods for utilization of surplus wastes and by-products from the fruit and vegetable processing industry.

1998 Non-R & D Recommendations

A. Support for Food Research and Personnel Needs

1. **Improve the accessibility of R & D matching funds from provincial and federal sources for food research.**

2. **Address the need for additional food-related research expertise in meats, fruits and vegetables, and cereals.**

Agricultural Research Institute of Ontario
The ARIO recognizes the need for additional expertise in meat processing research and has communicated this weakness in the existing OMAFRA/University of Guelph food research program to the executive of the program. The ARIO will continue to monitor the program and encourage the university to put research expertise in place which can address OASCC priorities.

Food Science Dept., University of Guelph, Dr. Rickey Yada
Support this recommendation, but feel that the pilot plant facilities could be upgraded and that a plan should be put in place for continuous maintenance and upgrading.

Canadian Meat Council, Carla Abbatemarco
Support University of Guelph tenured position in Meat Science.
The Technical Committee strongly supports this recommendation; however Council does not have the funds to provide assistance in this regard.

B. Regulatory Matters

3. **Ensure compliance of imported fresh and processed products with Canadian regulations.**

4. **Establish quality and procedural standards for partial processing of fruits and vegetables.**

OMAFRA Food Inspection Branch, Robert Forrest
You may or may not be aware that staff at the Canadian Food Inspection Agency have developed a document entitled "Code of Practice for Minimally Processed Ready to Eat Vegetables". It was distributed to Ontario industry in late March of this year. In addition The United States Department of Agriculture, Agriculture Marketing Service released a document entitled ""Qualified Through Verification"(QTV) Program for the Fresh-Cut Produce Industry" in February of this year. These 2 documents would likely address many of the concerns resulting in the above recommendation.

In addition, Ontario has the lead role in the development of a National Horticulture Code. Standards such as those proposed are a high priority for development. I am chairing this process and would be pleased to discuss it with you or other interested parties.

5. Validation of effectiveness of HACCP programs in the reduction of foodborne illness.

Lacombe Research Centre, Dr. D.R.C. Bailey

Risk assessment models can only be as good as the information and assumptions on which they are based. At present, needed information is often lacking and assumptions made in the construction of models are often erroneous. For example, current models for risk from E. coli 0157:H7 infection associated with the consumption of hamburgers all assume that contamination of meat with the organisms occurs during the dressing of the carcasses of animals that were shedding E. coli 0157:H7. In fact, data indicate that contamination is occurring from improperly cleaned equipment during the breaking of carcasses. Models can then do no more than quantify current understanding of risks, which are often far from complete. Thus, at present, modeling cannot be used to validate HACCP programs, and it is misleading to suggest that it can.

Food Science Dept., University of Guelph, Dr. Rickey Yada
See HACCP comments earlier.

Agree. Need some models. Some work is currently done at U of G with an OMAFRA support (e.g. Dry fermented sausages - use of E. coli 0157 to monitor the drying process - and develop a model system).

Health Canada, Dr. Susan Read
With respect to non-R&D recommendation #3, Health Canada is placing increasing emphasis on designing projects with the objective of demonstrating the impact on public health of food safety system policies and interventions. We have initiated some work in this area, but are still in the early stages of designing appropriate studies.

Agriculture and Agri-Food Canada, Greg Poushinsky
In general the research carried out by the Microbial Food Quality team of the Food Research Program, Guelph, is related to identification and control of pathogenic bacteria. Information will be published that will be applicable to the development of HACCP strategies. Specific research that is of use includes the development of a rapid bacterial enumerator, and assessment of probiotics to reduce salmonella in poultry.

C. <u>Communications with the Public and the Industry</u>

6. Reconsider the role of OASCC in response to recommendations.

D. Education and Training

7. Continue efforts on consumer education to increase the understanding of food quality and safety.

8. Evaluate consumer education as a food safety intervention strategy.

9. Develop information regarding healthy meat consumption.

Canadian Meat Council, Carla Abbatemarco
Developing information regarding healthy meat consumption. The National Institute of Nutrition and producer groups already have this information. The Canadian Food Information Council will also have this information. The Canadian Meat Council is developing a Crisis Manual to deal with emerging issues.

E. Strategic Alliances

10. Form an alliance of researchers at different branches under an umbrella organization to tackle research problems requiring a multi-disciplinary approach.